

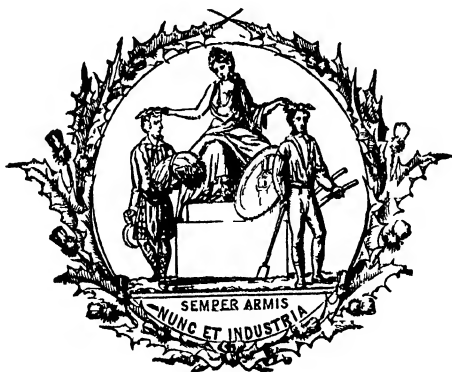


AGRICULTURAL RESEARCH INSTITUTE
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TRANSACTIONS
OF
THE HIGHLAND AND AGRICULTURAL
SOCIETY OF SCOTLAND

WITH
AN ABSTRACT OF THE PROCEEDINGS AT BOARD AND GENERAL
MEETINGS, AND THE PREMIUMS OFFERED BY
THE SOCIETY IN 1916

PUBLISHED ANNUALLY



FIFTH SERIE.

VOL. XXVIII.

EDITED BY JOHN STURTON, SECRETARY TO THE SOCIETY

EDINBURGH:
WILLIAM BLACKWOOD & SONS, 45 GEORGE STREET
AND 37 PATERNOSTER ROW, LONDON

1916

WORKS ON AGRICULTURE, &c.

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TRANSACTIONS
OF
THE HIGHLAND AND AGRICULTURAL
SOCIETY OF SCOTLAND

THE MAKING OF THE SOIL.

By E. J. RUSSELL, D.Sc., Rothamsted.

THE complete story of the making of the soil goes back to the far-off days when the earth first cooled sufficiently to have a solid crust, and the waters and air began to chip off fragments which, after many wanderings and changes, appeared at last as particles of sand, silts, clays, &c. The weathering processes have been operating all through the ages; much of their work is done so slowly that its progress has hardly been perceptible during the period that man has been on the scene; he can do very little either to help or to retard them. Clay soils were clay before man came, and will probably be clay after man has gone. Sandy soils and loams persist unchanged whatever we do to them. The mineral part of the soil may be taken as unchangeable by any human device.

But the mineral particles alone do not constitute the whole soil. It is common knowledge that a surface freshly exposed by a cliff-fall, landslip, &c., is quite different from ordinary soil in colour, texture, and especially in suitability to plant growth. The practical man speaks of it as crude, raw subsoil, requiring to be mellowed by the air before it is good for plants. That is partly true, but it is not the whole truth.

The process by which crude mineral matter changes to soil can be watched on cliff-falls, and is being closely studied at Rothamsted, where a quantity of subsoil has been put into a

THE MAKING OF THE SOIL.

brick chamber constructed expressly for the purpose (Fig. 1). The first thing that happens is that a few hardy plants manage to get a footing and make some sort of growth. They take what they can from the soil, and with this and the carbonic acid and oxygen from the air, they build up their tissues. When they die their roots, leaves, &c., mingle with the soil and decay; everything taken from the soil, excepting only the water, is returned. Thus the next generation of plants has its soil food from two sources: it can draw on the mineral particles for whatever it can get, and it has also the material that was taken by the previous race of plants and then set free again.



Fig. 1.—*Brick chambers filled with subsoil, the conversion of which into surface soil is being studied at Rothamsted.*

They are heaped up now so as to allow for the settlement that will gradually take place.

But there is a much greater change. The plant substances contain stores of energy derived from the sunlight, and this is liberated during decay just as completely as if the material was burnt in a bonfire, though, of course, more slowly. These stores of energy make life possible, and a vast population springs up of organisms specially adapted to live in the soil, drawing their food and their energy from the residues of the dead plants. During the process they fix some of the nitrogen from the atmosphere, and they resolve the dead plant residues into simple substances.

Now it so happens that the simple substances so formed include some that are needed by the new generation of plants;

indeed it is only by the activity of the micro-organisms that the plants get these foods. The living plants are therefore dependent on the soil micro-organisms just as completely as the soil micro-organisms are dependent on the dead remains of older plants.

Thus there is a great cycle of changes. Plants take up nutrients from the soil and the air, catch the sunlight, and build up complex materials containing stores of energy; when they die these stores of material and energy are added to the soil: this is the up-grade of the cycle. Then the micro-organisms attack the complex materials, break them down, liberate the

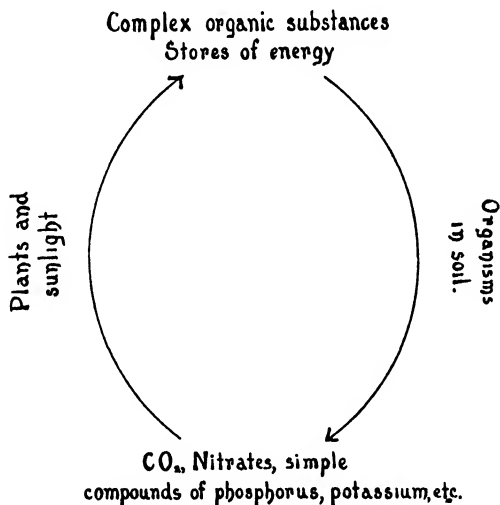


Fig. 2.—*Diagram illustrating the cycle of changes going on in and above the soil.*

Complex organic substances are made by the growing plant; these, when added to the soil, furnish food and energy for the micro-organisms. In return the organisms make fresh food for new generations of plants out of these old plant residues.

energy, and give rise once more to the simple materials with which the growing plant starts: this is the down-grade of the cycle. It is this cycle that characterises the soil and distinguishes it from the original raw mineral matter.

In order that the plant residues should decompose satisfactorily they have to mingle thoroughly with the mineral particles. This is brought about by earthworms, which have a remarkable power of casting up little heaps of soil out of their burrows, thus gradually forming a new surface layer. This action was first described by Darwin. It is illustrated very well by one of the Rothamsted fields, part of which was laid down to grass in 1874, while the rest remains arable land. The

field is very stony: the arable part contains 356,000 lb. stones in a total weight of 1,320,000 lb. soil per acre in the top 4 inches, being 27 per cent of the whole. But the grass part is no longer stony; the top 4 inches is nearly free from stones, containing only 52,000 lb., or 5 per cent of the whole. The stones have not disappeared, but they have been gradually submerged in the thin layers of soil perpetually being thrown up by the earthworms. This is shown in Table I.

TABLE I.

PERCENTAGE OF STONES IN ARABLE LAND AND IN LAND UNDER GRASS FOR 40 YEARS.

	Arable Land.		Grass Land.
	Dunged.	Unmanured.	
1st inch . .	26	58	Nil
2nd " . .	20	15	Nil
3rd " . .	16	23	Nil
4th " . .	15	30	12
5th " . .	19	21	32
6th " . .	15	20	29
7th " . .	20	19	15
8th " . .	23	19	18
9th " . .	20	16	26

Sections similar to these may be seen almost anywhere where native vegetation flourishes and leaves the earthworms undisturbed. They have sometimes given rise to the idea that the layer of fine earth overlying the rock has been produced by the disintegration or weathering of the rock. The actual particles were formed this way, but the layer was not; it arose from the slow action of earthworms in sorting out the soil from the stones and throwing it up on the surface. A good illustration is shown in Fig. 3.

It takes some time, of course, to get the whole chain of processes going. This is brought out very clearly in the attempts to plant the waste-mounds of the Black Country of Staffordshire. An enormous area in this region is covered with spoil-heaps containing the refuse from coal-mines, furnace ashes, slags, &c. These were dumped as convenience dictated, and no attempt was made to keep them reasonably levelled, or to cover them with any of the soil that they gradually overspread. For over a century the dumping has continued, and now the heaps extend over many thousand acres of land. In 1886, however, a great area near Walsall was laid out as a public park, part of it being sown with grass and part being planted

with trees. For the grass it was only necessary to pick up the surface, sow the seed, and give a good dressing of road-sweepings; nothing has been applied since. The trees were planted in pockets of earth, out of which, however, they have long since grown.

The original material was the shale—locally known as “clunch”—that forms the partings between the coal-seams, and had to be removed in great quantities during the working of the pit. It came out in flaky masses, but it speedily disintegrates to a clay that becomes extremely sticky in wet weather.



Fig. 3.—Action of earthworms in sorting out fine particles of soil and bringing them up as a layer of fine earth on the surface.

In the illustration this layer is 6·9 inches deep : this is quite usual in the southern counties.

Both the grass and the trees have made satisfactory growth, and the Park is an admirable demonstration of the way in which an unsightly waste-heap can be converted into a picturesque pleasure-ground. Our interest, however, is in the soil changes. The raw mineral matter is gradually undergoing conversion into soil; but even after thirty years the process is still far from complete. There is as yet no notable difference between the surface and the lower layers, and nothing to mark out the surface-soil from the subsoil. The colour is uniformly greenish-grey, with no break anywhere and no sign of reddening. Chemical tests showed that some oxidation had

taken place in the top 9 inches, the ferric iron being 50 per cent of the total iron, while in the second 9 inches it was only 40 per cent. There is also more decaying organic matter in the top layer than lower down, and therefore more nitrogen. This will in time lead to the formation of a normal soil, but it has not yet done so. The numbers of bacteria are all very low, ranging from 0·2 to 3·5 millions per gram, and averaging 1·5 millions, while even in a poor normal soil they run about 6 to 10 millions per gram. There are not many earthworms yet. Further, the wild vegetation is mainly of the type that grows on exposed subsoils—*e.g.*, coltsfoot, equisetum, *Lotus corniculatus*, &c.,—although in places some of the grasses are coming in. The analytical results are as follows:—

	Waste heap planted thirty years ago.		Usual for normal soil of similar type.	
	Top 9"	2nd 9"	Top 9"	2nd 9"
Nitrogen, per cent	0·11	0·07	0·18	0·10
Bacterial numbers, millions per gram	1·5	0·2	5 to 10	

Once the process gets well going, however, it proceeds more rapidly, and, as we shall see, in ordinary agricultural soils it is fairly quick.

The Soil Cycle and the Cultivator's Art.

The up-grade in the soil cycle causes accumulation of fertility in the soil; the down-grade causes the release of fertility and the production of plant-food. The cultivator's art, therefore, consists in making the most of the natural cycle: of arranging that at one period fertility shall be stored as quickly and as extensively as possible, and that at another period it shall be liberated as completely as possible when it is wanted.

Fortunately the cycle moves far more rapidly than the processes forming the mineral particles, so that it is much more under human control.

Three things are involved: the mineral particles; the supply of organic matter, which we may look upon as the raw material out of which the plant nutrients are to be made; and the soil organisms, which constitute the workers in the process. The mineral particles, as we have seen, cannot be altered. The best that can be done is to mitigate their properties. The supply of organic matter is under control, and to some extent also the soil organisms.

The Supply of Organic Matter.

One of the first discoveries made by arable farmers was that land cannot advantageously be cropped indefinitely; sooner or later it becomes exhausted. It was also discovered very early that "exhausted" land recovered if left to itself for a time, so that natural vegetation could spring up. Exhausted land, in fact, is land in which the soil cycle has temporarily slowed down because the stock of easily decomposed matter is used up, and the remedy works because it allows the stock to be replenished. In the oldest systems the land was cropped for a time, and then left alone for a while to "rest"—*i.e.*, to grow what it would. This system became regularised in the early days of civilisation: thus, in the Mosaic law, the Jews were commanded to leave their land untilled one year in seven, and not to reap "that which groweth of its own accord," but to leave it. In Saxon and mediæval times the land was uncropped one year in three; grass sprang up on the stubbles, it was grazed, and afterwards ploughed in. Something very similar can still be detected in parts of Connemara and in other remote districts in these islands. The land is cropped for three years, or at the outside four, and then it is "spent," and is left for a period to become covered with whatever happens to spring up,—the mixture being by courtesy called "grass."

In modern North Country farming exactly the same principle is adopted: the land has a course of arable crops, and then is left untilled for several years. But instead of letting it cover itself with any casual vegetation that comes, it is seeded with a definite mixture of grass and clover, chosen so as to make vigorous growth. A good mixture not only furnishes organic matter for the soil, but also provides a considerable supply for live stock.

A modification of the system that has the advantage of giving a larger gross return over the whole of the arable land consists in growing the clover mixture for one year only. This was recommended by Weston in his very interesting 'Discourse of Husbandrie used in Brabant and Flanders,' published in 1650 under Hartlib's name, and it was introduced into practice by Townshend as the result of his brilliant experiments started in 1730. Clover was taken as a preparation for wheat instead of the bare summer fallow that was then common; it furnishes hay for the live stock, and then gives a second growth, which can either be fed off on the land or else ploughed in. This was a magnificent improvement, but it only travelled slowly, and when Lawes and Gilbert started their experiments in 1843 the advantage of the clover course

was so little known that they made it the subject of one of their classical experiments (Fig. 4). Even now, the method has not been developed anything like as fully as it might be. It is only ten years ago that Sir Robert Wright (then Principal Wright) carried out experiments to demonstrate the value of sowing clover along with the lea oats in spring, a practice which, he states, "has recently been introduced" in Scotland.

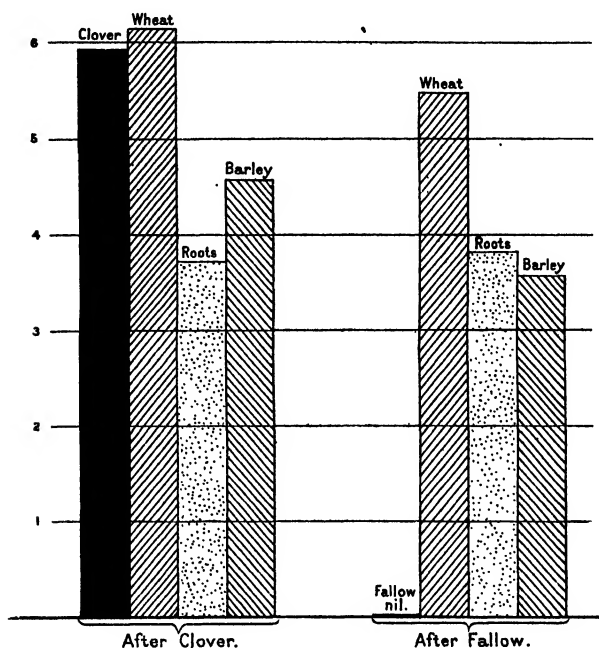


Fig. 4.—Effect of clover on the succeeding crops, Rothamsted.

One-half of the field is under the rotation: clover, wheat, roots, barley; and the other under bare fallow, wheat, roots, barley. The clover not only yields a good crop of hay but benefits the succeeding wheat and barley. The figures stand for thousand pounds of total produce of clover, wheat, and barley, and 100 cwt. of roots.

After the oats have been harvested the clover continues to grow, and not only furnishes additional keep for grazing stock but benefits the next crop.

The average results for three years for barley following the oats were¹—

No Clover.	Clover.	
2532	2987	lb. grain per acre.
26½	32½	cwt. straw per acre.

¹ 'Standard Cyclopædia,' vol. iii. p. 135.

A third method consists in growing a crop exclusively for the purpose of ploughing it in. Like many other modern schemes this goes back to very ancient times. Theophrastus, writing 300 years before Christ, says that in Macedonia and Thessaly beans were grown to be ploughed in at flowering time.¹ Varro, about 50 B.C.,² says, "Some things should be sown with a view not so much to present profit as to next year's crop, because when cut down and left there they improve the soil. Thus, lupins, before they produce many pods, and sometimes beanstalks, if the podding stage be not so far advanced that it is profitable to pull the beans,—are usually ploughed into poor land for manure."

Although it is so old, this practice of ploughing in green crops only slowly came into Britain. Donaldson, in 1796,³ says that it was scarcely known in Scotland, and not much practised in England; he only knew of it in Warwickshire, and to the two crops just mentioned he added only peas, tares, and buckwheat as suitable.

When the method was tested experimentally a generation ago a whole year used to be devoted to the green crops, so that two could be grown in succession and each ploughed in. But nowadays time has become more important on the farm, and instead of spending a whole season on them, farmers try to get in the "green crop" in a blank period, between two others: hence their older name "stolen crops."

Whichever of the above two methods is adopted two types of plant are suitable for the purpose.

(a) *Spring-sown crops* growing slowly in their early stages, so that they can be sown in the cereal crop without fear that they will swamp it or be themselves swamped. Clover satisfies this condition, and is very profitable for the purpose. The great advantage of these crops is that sowing is easy, and rapid growth begins with the first rain after the harvest.

So far as is known, the cereal crop does not suffer from the admixture of clover; indeed, some of the American experiments suggest that it may gain. More plants of this sort are badly needed, especially for soils that will not take clover frequently.

(b) *Autumn-sown crops* that grow quickly in their early stages, and do not require much preparation for the seed-bed.

Trifolium serves very well where it succeeds; it tolerates a hard seed-bed, so that it can simply be harrowed in on the stubbles. Unfortunately it is delicate, and cannot be depended upon in the North.

¹ 'Historia Plantarum,' lib. viii. cap. 9. Pliny also states this in his 'Natural History,' lib. xviii. cap. 12.

² Varro, lib. i. cap. 23. Storr-Best's translation.

³ James Donaldson, 'Modern Agriculture, or the Present State of Husbandry in Great Britain.' Dundee, 1796, vol. ii. p. 232.

Mustard is admirable, and in numerous experiments has proved of great value, sometimes, indeed, giving better results than a dressing of dung.

Leguminous crops have the advantage that they increase the stores of nitrogen in the soil, but this is not the only factor, and the non-leguminous crops, as shown by experience with mustard, prove very useful. Indeed, on the lighter sandy soil at Woburn the non-leguminous mustard gives better results than the leguminous vetches. This is not universal: a different result was obtained on the heavier soil at Rothamsted, but it shows that non-leguminous plants can be used under proper circumstances with perfectly satisfactory results.

	YIELD OF WHEAT, BUSHELS PER ACRE.				
	No green crop.	After vetches.	After crimson clover.	After mustard.	After rape.
Light land at Woburn.	10.1	15.1	...	25.1	20.4
Heavy land, Rothamsted	17.5	36.3	28.3	25.8	22.6

The great advantage of this method of adding organic matter to the soil is the completeness with which it is under control. The size of the green crop may be controlled by treating it with artificial fertilisers.¹ It is even possible to exercise some control as to the nature of the compounds thus added to the soil. Crops can be chosen for the sake of some special substance: experiments are in hand to ascertain if it is possible by this means to control any of the soil pests. Again, the crop can be fed to animals on the land so that their excretions fall straight on to the soil. It so happens that the animals excrete most of the constituents really wanted by the plant, and they leave or excrete sufficient organic matter to benefit the soil considerably. There is certainly a great future for these methods, and our seedsmen and plant breeders might well turn their attention to the production of more suitable varieties.

The Limits of the Process.

The processes just described add considerably to the fertility of the soil. The green crop during its lifetime built up organic matter; it took from the soil soluble nutrients, particularly

¹ Dr Somerville has recently shown that better arable crops are obtained from ploughed-up grass land which has been improved by basic slag than from untreated grass land (*Journ. Board of Agric.*, 1916, vol. xxii. p. 1201).

nitrites, which might easily have been washed away; and if it was of the leguminous order, it increased the stores of combined nitrogen through the activities of its associated micro-organisms. When it is ploughed in all these things are added to the soil. After a course of green manuring, therefore, the soil increases in fertility.

But the process does not go on indefinitely: there is a limit beyond which organic matter will not accumulate in the soil by these natural processes. This is set by—

(a) The nature of the vegetation. In favourable conditions the vegetation may be of a bulky, easily decomposable type, very suitable for decomposition in the soil and for increasing fertility. In unfavourable conditions the growth of the green manure crops may only be small, and on the virgin land the native vegetation may not be at all suitable for the purpose: thus, heather, bracken, cotton-grass, gorse, pine needles, &c., are not promising materials for the soil cycle.

(b) The losses. These arise from bacterial action, from rain, and other weather agencies.

In consequence there is a limit to the accumulation of fertility, and even in virgin soil the stock is not indefinitely great. The percentage of nitrogen is a useful index, and although it is not the only criterion, it sufficiently serves our purpose.* The following are some results:—

	Sandy heaths, Norfolk. Virgin soil.	Loams. Very old grass.	Pasture for 40 years.	Prairie loams.	Black soils, Manitoba.
Nitrogen, per cent .	0.10	0.25	0.20	0.4	1.0

The black soil of the prairie owes its colour and richness in nitrogen in part to its geological history, and not solely to its undisturbed condition.

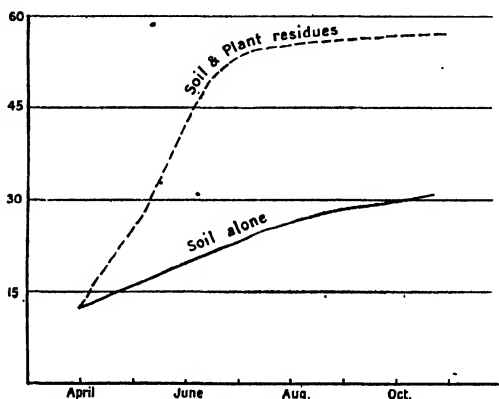
Data have not been obtained to show how far fertility can be accumulated in farm soils by ploughing in green crops, but there is no doubt it is equally limited there also.

The Release of Fertility.

The farmer's object, however, is not to accumulate fertility but to use it: the accumulation is only made for the sake of breaking it down again. During the growth of the green crop the activities of the soil organisms seem to be rather suspended, but after the ploughing-in they become very active. Plant food is produced at a great rate (Fig. 5), and unless

a crop is there to take it up, and able to grow sufficiently to take it all up, there is considerable loss. This, unfortunately, is a common occurrence in virgin lands. For various reasons the crop is limited to some 25 bushels of wheat, or even less, which does not require very much plant food: any excess left unused is wasted. It is not uncommon after twenty years of prairie cultivation to find that only one-third of the nitrogen lost from the soil has gone into the crop. If bigger crops had been possible the plant food could have been more completely used.

Thus the building-up and the releasing of fertility are both carried out on the principle of assisting Nature. In the build-



EFFECT OF PLANT RESIDUES ON NITRATE PRODUCTION IN SOILS.

Fig. 5.—Showing how rapidly nitrates are produced in soils where plant residues are added.

The lower line shows the amount produced in the soil alone; the dotted line the amount formed when plant residues are put in. The figures represent parts of nitrogen per million of dry soil.

ing-up process the farmer grows crops which add organic matter to the soil, and he either ploughs them all in or else ploughs in part and feeds the rest to animals, whose excretions will be ploughed in. This imitates the natural process by which soil was formed and fertility first accumulated.

In the reverse process of breaking down the fertility and utilising it, he must assist the micro-organisms, and this is best done when growing vegetation is out of the way: hence, cultivation and tillage are carried on for as long as possible. But as plant food cannot be stored indefinitely in the soil the conditions must be made as favourable as possible for the growth of the crops, so that the whole of the plant food shall be utilised, and none left over to waste.

Finally, if the process of cropping goes on too long without

any addition of organic matter the soil cycle comes to a standstill, and the land is said to be exhausted.

The perennial controversy as to whether grass or tillage is the better husbandry, with its numerous political, social, and economic aspects, has also a fertility aspect. From the soil point of view grass stores fertility, but does not use it fully, while tillage uses fertility, but does not store it.

The modern movement is against too much grass. That prince of farmers, Mr Strutt, not long ago published his returns per acre for a period of eighteen years, and showed that grass does not give anything like the gross return or profit that arable land gives. Some of his figures are as follows:¹—

AVERAGE PROFITS PER ACRE, 18 YEARS, 1894-1911.

	£	s.	d.
Potatoes	4	13	1
Wheat	2	18	8
Winter oats	2	18	6
Red clover	2	11	6
Barley	2	3	4
Mangold	0	18	2
Permanent grass	0	7	11

Mr Middleton² has more recently shown that the proposition is generally true, and, from whatever point of view the matter is approached, arable land comes out best.

An interesting experiment is now being conducted under Mr Gavin's supervision on the Duke of Marlborough's farms at Blenheim, Oxford, where some of the grass land is being ploughed up, so far with entirely successful results. The total output has increased, and also the net profits,—both highly desirable achievements. The soil is ploughed to a depth of about 5 inches, and is turned *completely* over, then a roller is sent over crosswise to press the grass right in so that it does not spring up again. If the grass is not buried it causes endless trouble by growing again.

The soil is eminently suitable for arable crops, being a nice loam on the cornbrash, one of the most tractable formations in the country. It does not follow that equally good results would be obtained on heavy clay grass land, nor that it is economical to break up valuable pasture or meadow land.

But the general economic position demands that the utmost should be got out of the land, and that the accumulated stores of fertility should be drawn upon as completely as possible. The aim should be a combination of the two processes: storage

¹ *Trans. Surveyors' Institute*, 1913.

² *Jour. Bd. Agric.*, 1915, vol. xxii. p. 520.

are the insect pests—wireworms, &c.—which accumulate seriously in cultivation under glass, and may cause grave trouble when grass land is ploughed up. At the present time these constitute one of the great obstacles to the proper utilisation of accumulated fertility. In many cases farmers have learnt various methods of cultivation which enable the plant to keep growing in spite of the pest, but where the pest becomes bad they must either grow some non-susceptible crop, such as beans, or leave the land fallow. It is hoped that more direct methods will be available before long.

The Speeding-up of the Soil Cycle.

The up-grade, or the accumulation of fertility, requires the free growth of plants so as to form copious residues; the down-grade, or liberation of fertility, requires the free growth of micro-organisms. The speeding-up of the cycle, therefore, involves the improvement of conditions for the growth both of plants and of micro-organisms, and it is extremely fortunate for the farmer that both plants and micro-organisms require the same conditions, so that anything that benefits one part of the cycle also benefits the rest. These requirements are—

1. Air.
2. Water.
3. Proper temperature.
4. Proper food.
5. Proper root-room.
6. Absence of harmful conditions.

Unless every one of these is met the plant is likely to fail. No amount of water, for example, will make up for lack of temperature, and although the actual amounts of food wanted depend on the water supply, the rule holds good for all these things.

Any requirement that is not met puts a limit to further growth: it is therefore called a *limiting factor*. Success in soil management consists in discovering and removing the limiting factor. Common experience has shown what are the limiting factors on the ordinary classes of soil.

Soil.	Limiting Factor.
Clay . . .	Coldness, wetness, sourness.
Sand . . .	Dryness, heat. ¹
Chalk . . .	" "
Peat . . .	Coldness, wetness, sourness.

In the southern counties of England.

All of the soils may suffer from insufficiency of food, but it is not the object of this paper to go into the question of food supply, which is a whole subject in itself. We shall confine ourselves to a discussion of the other factors.

Study of the list brings out the interesting fact that coldness and wetness go together, and so do dryness and heat. It is obvious that if all four could be blended some desirable neutral condition might be attained. This was the principle on which the agricultural advisers of the old days proceeded. They suggested that soil improvement was simply a matter of creating the opposite condition. "Things become fruitful," says Evelyn in his 'Terra' (1676, one of the earliest British books on soil), "from the mixture of repugnant qualities." This was the principle adopted in the old style of medicine. While it looks charmingly simple on paper it breaks down in practice. Thus, the method suggested for improving clay was to add sand, and a number of experiments with this object are recorded in the eighteenth and early nineteenth centuries, but they commonly failed.

The modern principle of discovering and removing the limiting factor is much sounder.

Wetness.—Only one method has been discovered for dealing with this, and that is some form of drainage. It is an old art that was forgotten for a long time. It is described by Columella,¹ who wrote about 60 A.D., but is not mentioned in British books in the great revival of the sixteenth century. Gervase Markham, for instance, wrote books on almost every branch of farming from marling to horse-breeding—so many, indeed, that his publishers made him sign a contract to write no more—but never one on draining. But by the middle of the seventeenth century it was common, and in Blith's 'Improver Improved' it is dealt with at great length, and full details are given for taking the necessary levels.

The old drains described by Columella, and used in Suffolk and Essex, were made by digging trenches, laying stones in the bottom, and filling in again; where stone could not be had brushwood or sticks were used instead. These bush-drains are fairly durable: they are still made in parts of Suffolk. The trench is dug about 18 inches deep, according to the land, and tapering to 3 inches width at the bottom; hedge-trimmings are then laid in, and the earth filled up. The writer recently inspected some old bush-drains in Hertfordshire which still persisted. But their drawback was that they were not by themselves sufficient; the land had still to be laid into

¹ Lib. 2, cap. 2. He speaks of drains as "hidden ditches."

ridges or "stetches" just as if no system of under-drainage were used.

A very great advance was made when Elkington, in 1764, tried to drain the wet Princethorpe farm in Warwickshire he had recently inherited from his father, and, in despair at ever making it dry, one day seized a crowbar from a labourer and drove it hard into a new ditch that was being dug. Water rushed out, and Elkington realised why previous efforts had failed: the ditches had been made to take off surface water, while the real source of the trouble was the hidden spring. He therefore made his new drain along the outcrop of the spring, but at a lower level, and led it into a brook: from that time on he was no longer troubled with wetness. So successful was he in the Midlands that his crowbar became likened to the rod of Moses. But the method did not always work in other people's hands: springs were not always the cause; and in the years of depression following the Napoleonic wars drainage was neglected. The next move came when James Smith, manager of the cotton works at Deanston, in Perthshire, between 1820 and 1830 drained a marsh with stone drains and converted it into a garden. This showed what could be done, and the ingenuity of inventors soon caused drain-pipes to be turned out by the thousand at very cheap rates. Drainage was thus facilitated, and numerous large schemes were carried through. Unfortunately much of it was done before the underlying principles were worked out, and so the drainers did not always know exactly at what they ought to aim. Thousands of acres of land were wrongly drained, and thousands of pounds wasted before it was discovered that two separate cases have to be dealt with—underground water, which requires deep drains, and surface water, which has to be carried off by shallow drains. The lesson is a useful one that ought never to be forgotten. Progress can be made by the empirical or hit-or-miss method where numbers of trials are made on the off-chance that one will turn out a success; or, on the other hand, by the scientific method, where investigations are made to find out exactly what are the conditions to be met, and the underlying principles; and, when these are known, trying to work out a practicable method on a sound basis. Experience has shown that the scientific method is both safer and cheaper than the other, and one of the many illustrations is afforded by the history of drainage.

Wherever pipe-drainage was properly carried out it was very successful, and more efficient than the older methods. The land did not need to be kept in ridges: it could be laid flat. Thus for the first time the heavy-land farmer was able to get rid of the furrows where crops would not grow well, and where, therefore,

weeds got a hold and spread their seeds all over the land. He could also on the flat land use binders and the newer cultivating machinery, and could cross-plough and do other various operations never before possible. More than that, the improvement in the soil conditions enabled the plant to start growth earlier and to continue later; made it possible to grow some of the more delicate crops, such as turnips, and thus to increase the output of animal food; and, generally speaking, it increased the possibilities of crop growth so much that artificial manures could be used with advantage.

As a farming operation becomes better developed it becomes more difficult to suggest improvements. Attention can then profitably be directed to the reduction of costs. Pipe-drainage



Fig. 6.—*Mole plough, modern.*

Messrs Howard's plough for steam traction.

was always expensive, and for some years past landlords have not always considered themselves justified in carrying it out. Fortunately a far cheaper substitute has been developed which promises to work equally well; it is known as mole-draining. It consists in forcing a steel cylinder with a pointed end through the soil so as to make a tunnel about 9 to 18 inches below the surface (Fig. 6). Naturally this method only works in soils which are sufficiently heavy for the tunnel to hold up, and the subsoil must therefore be tested before the process is begun; if it crumbles in one's hands it is unsuitable. A common price in the Midlands is £1 per acre, which is considerably less than even the cheapest form of pipe-drainage. The benefits are considerable. I have at present under observation an area of grass land that used to be very wet during the winter, but since mole-

draining it remains firm and dry, with obvious advantage both to grass and stock.¹

The practice is really old: it was used by Adam Scott at the end of the eighteenth century, and an early form is shown in Fig. 7, taken from R. W. Dickson's 'Practical Agriculture,' published in 1807. This was hauled by a windlass worked by eight women, each paid 8d. per day.

Dryness.—If the overcoming of wetness was the great triumph of our grandfathers, we can reasonably claim for our generation that it has gone a long way towards overcoming the difficulty of dryness. Considerable parts of Britain are affected this way, especially the sands and gravels of the Eastern and South-eastern counties. The old English farmers hated dry soils: they cultivated the loams and clays, but left the dry sands as wastes

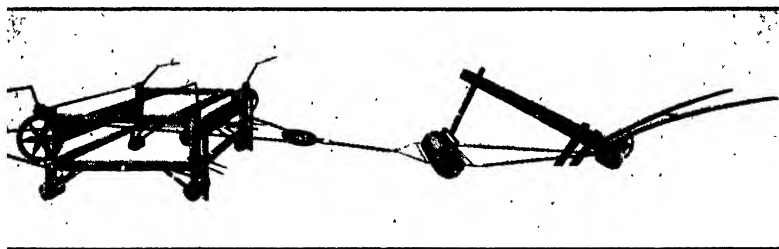


Fig. 7.—*Mole plough, ancient type.*

This is described in Dickson's 'Practical Agriculture,' 1807, and was hauled by the windlass worked by eight women.

to become tenanted by highwaymen, footpads, and other picturesque personages of that type. From Shakespeare to Cobbett a long list of writers said their worst about this kind of country: "blasted heaths," "villainous holes," "rascally heaths"; while Hindhead in Surrey, now the most favoured of residential spots outside London, was, in Cobbett's view, "certainly the most villainous place God ever made." The old method of treating this kind of soil was based on the old principle of working by contraries and adding the opposite,—it was to add clay, or better still, marl. But even in the old days of cheap labour this was not commonly done, and it only succeeded where clay lay just under the sand, or within easy reach by tramway, so that it could be brought up and put on to the surface. This

¹ The last part of the run near to the watercourse has to be pipe-drained. If the pipes are made to discharge straight into the watercourse they will tend to splinter badly with the frost and to fall out, so that the opening fills up and the drains become blocked. The trouble can be obviated by discharging into a drain parallel to the watercourse so that one opening only is necessary; this can then be of brick. Mole-draining does not work where there are large stones in the ground.

was done by Coke at Holkham, by the Duke of Bedford at Woburn, and still later in Delamere Forest, Cheshire. A great tract of sand lying between Ghent and Antwerp, and known as the Pays de Waes, was reclaimed in this manner at great labour.

But this method is generally too costly for modern conditions, and fortunately it is not necessary. The modern method of discovering and then removing the limiting factor allows of considerably wider scope. The limiting factor being dryness, the remedy is to increase the stock of water in the soil, and this can be done either by adding more water or by diminishing the losses. Direct addition of water is not now common in this country, although it was frequent in the old days of "watering" or "floating" meadows, and it might well be more often practised in market-gardening wherever little streams or suitable sewage effluents are available. The oldest schemes known are those of ancient Babylon in the country lying between the Tigris and the Euphrates. Left to itself this district is nothing but a wilderness; it bakes under the fierce sun, and sand blows in and covers it. But the land falls away from the Tigris to the Euphrates, and some forgotten genius discovered that canals could be constructed to connect the two rivers and to irrigate the whole area. It then became amazingly fertile. When history begins, some 7000 years ago, there was already a big network of these canals, and the irrigated land was made to bear two or even three crops of wheat a year, yielding a two-hundred to three-hundredfold return. Constant watchfulness was necessary; the canals had to be kept clean, or they became blocked and floods set in.¹ There must also have been some form of drainage, or the irrigated land would soon have been rendered useless by alkali.

Modern irrigation schemes aim always at combining irrigation with drainage, and considerable work has been done on the most suitable quantities of water for different crops, and on the causes of the alkali that sooner or later ruins most irrigated land unless it is checked.

In regions where the rainfall exceeds 15 inches per annum, and where, moreover, it is distributed favourably to plant growth, there is no necessity for irrigation: the natural supply is sufficient if it is properly husbanded. All loss and waste have to be reduced, and numerous investigations have therefore been made to find out how this could be effected. Two general methods are known.

Some of the soil constituents—the clay and some of the organic matter—have the power of absorbing water and holding it so firmly that it does not drain away or rapidly evaporate.

¹ C. H. W. Johns, 'Ancient Babylonia.'

One of the plots on the Broadbalk wheat field receives annually 14 tons of farmyard manure, while the adjoining plots receive none. The effect on the drainage is very marked,—the drains hardly ever running on the dunged plots, while they frequently run on the others.

NUMBER OF DAYS WHEN DRAINS RAN.

	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.	1914.	Average of twelve years.
Dunged plot . .	2	3	None	1	None	None	1	None	None	None	None	2	0.7
Unmanured plot	27	20	11	14	10	9	10	20	20	32	9	20	17

Fig. 8 shows the effect on the water content of the soils. The effect on the crop in a dry July is well shown by the mangolds in Barnfield (Fig. 9). The field is divided into strips

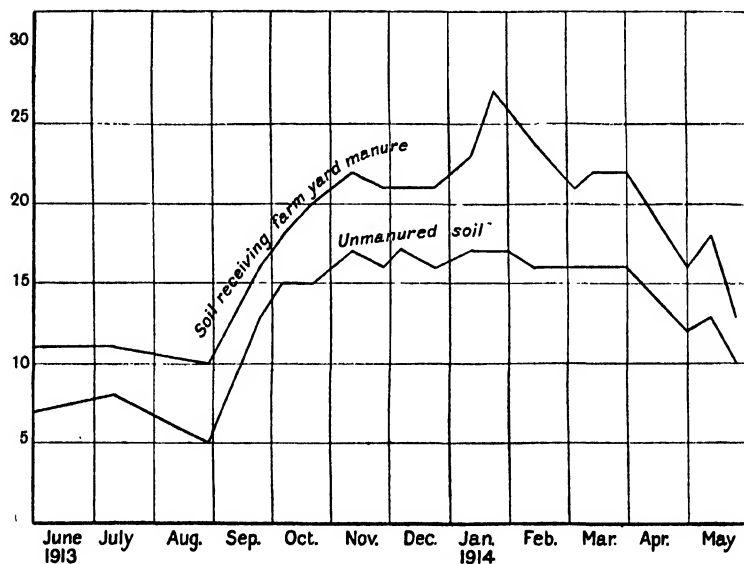


Fig. 8.—Effect of dung on the moisture content of soil.

The curves show the percentages throughout the year of moisture in plots receiving dung, and in adjoining plots receiving nothing. All through the year the dunged soil is the moister, and in a dry season is therefore the more favourable for growth.

running from top to bottom : those on the right-hand side receive farmyard manure, those on the left do not, but only combinations of artificial manures. Mangold seed was sown on the same day over the whole of the plots : owing to dry weather, germination

and growth were very slow, but the extra moisture in the dunged plot just enabled the plant to keep growing, whilst on the adjoining plots without dung they failed to grow. For this reason farmyard manure is indispensable on certain soils in the Eastern counties, and by no system of artificials can it be replaced.

Addition of clay has the same effect, but in practice it is less easy to carry out. Organic matter has the great advantage that it can be got on to the land without cartage: crops can be



Fig. 9. — *Effect of farmyard manure in conserving moisture in soil, July 1915.*

To the right of A the land receives farmyard manure, and is therefore moister than that to the left, which receives only artificial manures. In the dry weather, after sowing, this additional moisture proved very helpful, causing the plants to make considerable progress, so that by July the difference had become very striking. (Barnfield, Rothamsted.)

grown and ploughed in or fed to animals on the land, so that the organic matter increases in the soil with the minimum of trouble.

The second method of reducing the wastage of water is to make a layer of soil on the surface which may act as a non-conductor, keeping the sun's heat off from the main mass of the soil. Direct sunshine has a remarkably quick effect on soil temperature; indeed, at Rothamsted, the recording soil thermometer buried 6 inches in the soil might almost be used as a sunshine recorder. But if a loose layer of soil is kept on the top the direct rays of the sun are less able to penetrate, so that

the soil does not get so hot or lose its moisture so quickly. The formation of this mulch is brought about by surface cultivations, and this is the central feature of farming in dry districts. Disc harrows are sent out as speedily as possible after a shower of rain or whenever the soil appears to have become consolidated; a layer of loose soil $1\frac{1}{2}$ to 2 inches thick is thus maintained. This helps to conserve moisture. In unirrigated districts in Alberta it is sometimes found an advantage to make a whole year's fallow so as to increase the store of moisture in the soil for the next season. The crop, of course, will only grow to the limit set by the water supply, and no dry farming adds a drop of water to the soil, or produces any more growth than the water supply allows.

The agriculturist is not confined to such improvements as he can effect in the soil. Plants, even of the same species, vary in their water requirements, and it is possible to find varieties requiring less water than others. Wheat is selected on this principle in Australia, and varieties have been obtained possessing considerable power of resisting drought. Varieties of maize have been selected in the Western States specially because of their low water requirements, and in Nebraska good results have been obtained with a short small-leaved variety that needs no more water than can be got during the summer.

In consequence of these soil and plant improvements dryness no longer presents serious difficulties to the farmer, and land which a generation ago was marked "Desert Land" on the map is now coming into cultivation. The old "American Desert" is fast disappearing, and the "Great Desert of Australia" may be hoped to follow suit. Even our own Eastern counties' heaths are not hopeless, especially where the land is tolerably level and abuts on to higher land. Fig. 10 shows a reclamation in progress by Dr Edwards at Methwold, Norfolk: the bracken is first cleared off and piled into heaps to be burnt, and the ashes are spread; chalk also is applied. Then the land is cultivated deeply to tear up roots, break up rabbit-holes, and level it down generally. It is now ready for cropping, and only requires proper artificial manures to produce potatoes, lucerne, oats, and other crops.

Absence of Injurious Factors.—This is intended to cover almost everything left over, but the commonest are—

Sourness of Soil,—a condition which arises in cold, wet conditions, and

Alkali Soil,—which arises in hot, dry conditions.

Both are of great importance, but sourness is the only one that concerns us here. Its cause is rather obscure; it is often attributed to acids, but no acid has been extracted from soils in this country in any form satisfactory to the chemist. From



Fig. 10.—*Waste heath-land being reclaimed by Dr Edwards in Norfolk.*

The top part shows the first stage where the bracken has been collected in heaps for burning and the land left in proper condition for cultivation. The lower part shows the result: the land is carrying a good crop of potatoes, lucerne, &c.

the dawn of history it has been the bane of the Celtic tribes, and long before history begins they had discovered a remedy.

Pliny tells us how the Britons and Gauls used marl for "nourishing the land." They knew more than half a dozen varieties, grouped them into two divisions,—hard and fatty,—and considered that some were better for grain and some for grass. The most lasting was chalk, which was dug out from wells and spread on the land: its effects persisted for eighty years. To this day chalk is still drawn in Hertfordshire just as Pliny describes. Later on, however, burnt lime became more common: it is certainly easier to handle, as it is more evenly divided. But where fuel was dear the unburnt material was more popular. Limestone in broken chips was used in Oxfordshire;¹ powdered limestone in Ireland,² and also in Scotland;³ indeed, Lord Kames is said to have put up a mill for grinding limestone, "but it was unfortunately carried away by the burn that had worked it, and consequently it remains doubtful whether it would be advantageous to grind limestone for manure."⁴

Ground limestone is now available in quantity and is known to be beneficial. Numerous experiments have also been made with different forms of burnt lime. The liming of soils is therefore now one of the easiest of processes; unfortunately it is one of the most frequently neglected, and sadly needs to be brought in again.⁵

Depth of Soil.—However good a soil may be in itself, it achieves little unless there is enough of it to allow of proper plant growth. Throughout our island the natural vegetation goes down about six inches, and at this depth, therefore, the soil-making process has usually come to an end; below this is the original mineral matter out of which the soil was originally formed. This is shown in Fig. 11, where the percentages of nitrogen in each inch of old grass land at Rothamsted are plotted; the fall is very marked.

The plants grown by the farmer, however, are not the natural vegetation; they are, indeed, far from it. They have been selected and bred, and could no more survive under "natural" conditions than highly-bred stock. They want constant nursing from man, and they prefer a greater depth of soil than Nature usually affords.

It is therefore desirable to deepen the soil—*i.e.*, to make the subsoil like the surface soil. Two ways have been adopted.

1. *Imitating the Natural Process.*—The natural process of soil formation is for the roots of vegetation to decay, and thus to

¹ R. Plot, 'Natural History of Oxfordshire,' 1676.

² C. Varley, 'New System of Husbandry,' 1772, vol. ii. p. 46.

³ H. Home, 'Gentleman Farmer,' p. 264, 5th ed., 1802.

⁴ 'Gleanings from Books on Agriculture,' 1802, p. 244.

⁵ See a striking leaflet recently issued by the Scotch Bd. of Agric., No. 20 1915.

mingle with the mineral matter. Since the natural vegetation stops at about 6 inches in this climate, the surface soil also stops there. If one wants to extend the surface soil, the obvious plan is to replace the natural vegetation by other vegetation which will go down deeper, and this is the plan adopted by Mr Elliott.¹

The land is ploughed up and then sown with vigorous deep-rooting plants, such as chicory, burnet, yarrow, kidney vetch, &c., and left for some years. The ordinary process of soil formation goes on, but it now extends to 8 or 9 inches,

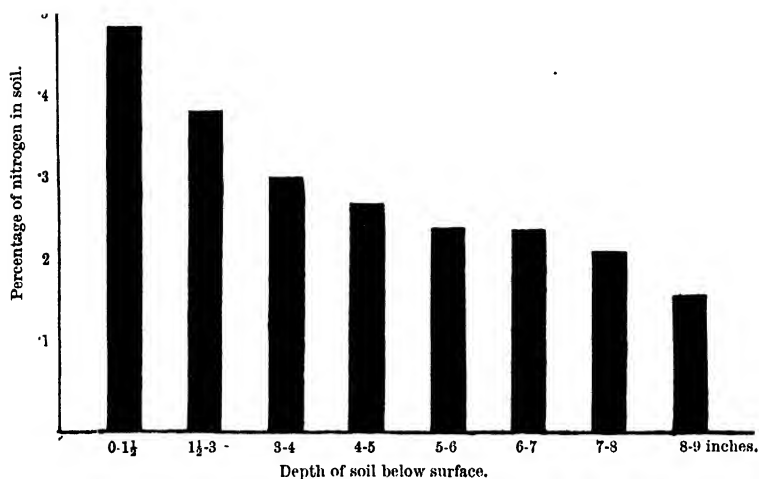


Fig. 11.—Percentage of nitrogen in soils of grass land, showing the fall as the depth increases.

the new depth of root range. After a time—which depends on circumstances—the process has gone sufficiently far to effect considerable improvement. It obviously has to be repeated fairly frequently to maintain the supplies.

2. *Making the Subsoil more Accessible.*—Gardeners can do this by trenching—i.e., burying the surface soil and bringing up the subsoil to the top where it can be got at easily, manured, cultivated, and transformed into soil. This method was used for wheat in the fifties: it was brought out by the Rev. C. Smith of Lois Weedon,² and caused no little sensation for a

¹ 'Agricultural Changes required by the Times,' 1st ed., 1898.

² Described in his pamphlet, 'A Word in Season.'

time. Labour was cheap, wheat was dear, and so was dung, and, moreover, wheat tolerates pretty well the sticky condition into which a raw subsoil is likely to get in winter. But the method failed at Rothamsted, and died directly prices altered.

Deep ploughing has proved considerably more successful. It has had a chequered history, and no small proportion of its failures arose directly through wrong teaching. Fifty years ago the subsoil was looked upon as the store of food for plants, requiring only the influence of weather to be released. Now we know that it is not, but that, so far from giving anything, it must receive something before it contributes to the fertility of the soil. The great advocate of deep ploughing in the old days—the fifties and sixties—was Mecchi¹ of Tiptree Hall, Essex, and he claimed to have increased enormously the productivity of his land by deep ploughing combined with drainage; roots, green crops, and clover especially benefiting by the treatment. But it was done without discrimination: a good deal of raw subsoil was brought up which seriously injured the heavy land, and in the bad days of the nineties farmers could not afford the necessary manure to put matters right. It is now, however, finding advocates once more, and very good results have been obtained by Mr Hailey in Hertfordshire by steam-ploughing 17 inches deep every five years. This is done in July, thus allowing ample time to work down the new surface by harrowing, &c., before the winter rain comes on. The subsoil is a sandy clay, by no means hopeless, and in the spring a dressing of soot is given, which, besides furnishing nitrogen, also improves the texture of the soil. The cost of the work is about £2 per acre.

This requires steam tackle. A method applicable on smaller farms, and costing very little, is to send the subsoiler after the plough. This gets down quite deeply enough, and it does not bring up much of the crude subsoil. The benefit is considerable; the following results were obtained at Rothamsted:—

	POTATOES.	WHEAT.
	1914. Tons per acre.	1915. Total produce, lbs. per acre.
Subsoiled in 1914 . . .	7·4	3598
Not subsoiled	6·9	3145

¹ 'How to Farm Profitably,' 1859, p. 132; also 'Farmer's Friend,' 1847, p. 228.

Occasional deep ploughing and subsoiling are especially good where a pan exists just below the surface soil. On many heavy-land farms wooden ploughs have been in use from time immemorial, and the cultivators were loth to change them, because they would get through the soil under almost any conditions, while the iron ploughs—or at any rate the earlier makes—would not. The heavy plough, however, had the disadvantage that it consolidated the soil into a “plough sole,” especially when it was drawn by three or four horses in the furrow and worked always at a uniform depth. This not uncommonly happens in the boulder-clay. In parts of Essex, for example, the layer of soil actually ploughed is only about 4 inches, and of course the crops are poor. Below this there is any amount of potential soil, but it is firmly sealed under the plough sole. The remedy is obvious; two things have to be done. A better type of steel plough must be obtained, which does not need to work at one uniform depth; and a subsoiler must be run behind it so as to tear up the plough sole. Deep ploughing alone is not sufficient: it might only make another plough sole lower down. It is by occasionally getting below the usual depth that the best results are obtained. Drainage is of course indispensable unless the subsoil is sufficiently pervious. Very satisfactory results have been obtained by this method in Essex.

The “pan” formed on certain sandy or gravelly soils, containing iron but deficient in lime, can be broken in the same way, and its formation prevented by deeper ploughing and applications of lime.

The trouble is far more serious when the material underlying the thin layer of soil is gravel. No one has yet evolved any satisfactory general method of treatment, and much of this sort of land is of very little use for crop production. It may serve other purposes, of course: gravel makes good residential districts, golf courses, &c., but for purpose of conversion into soil it is pretty hopeless on our present methods.

Rock is also seriously troublesome. In very moist districts a certain amount of pasturage can be got on thin soils overlying rock, but usually very little can be done. One case, however, is susceptible to treatment. If the rock is only a thin layer, and it is underlain by good material only wanting organic matter to make it into soil, the possibilities of improvement are considerable. Excellent results were obtained at Cox Heath, Maidstone. In its original state the soil was so thin that cropping was impossible; it was therefore left waste, and became the abode of gipsies, tramps, and other vagrants. But underneath the layer of rock lay mineral matter that had in it the makings of a good loam, as shown in Fig. 12. When the rock was removed and the upper and the lower layers joined, a

useful soil resulted: some was so good that it lets at £2 per acre, but some still required pretty heavy manuring. But it is now all agricultural land, whilst formerly it was waste.

A similar improvement is recorded in the Prize Essays and Transactions of the Highland Society of Scotland for 1831.¹ The estates of Auchtygall and Collilaw, in Peterhead, Aberdeen, contained much waste land, valued at sixpence per acre; all attempts at cultivation had failed. Examination showed that a moorband occurred just below the surface of the soil, but under this was a considerable depth of sand or gravel admixed with clay and sufficiently soft to be easily worked. The heath

SOIL SECTION AT COX HEATH.

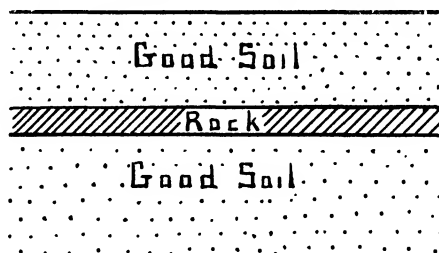


Fig. 12.—*Reclamation of Cox Heath, Muidstone.*

The soil was good, but was too thin. Underneath lay a band of rock, and below this again some more good soil. When the rock was removed, the whole became very productive.

and moss were therefore cleared away, and a hole was picked through the pan, into which the plough was made to enter. By dint of great labour the pan was pulled out, and the land then became productive.

The removal of rock is, of course, a serious business. These particular reclamations were brought about between 1814 and 1830, when wheat was even higher in price than it is now. Steam tackle might prove cheaper, but under modern conditions it would probably be simpler to blow the rock out with dynamite,—a mode of “culture” which had already begun to appear before the War, and which may develop considerably afterwards.

How far can Soil Improvement go?

Agricultural improvements may take place in two directions: the yield may be increased, or it may be obtained at less labour—*i.e.*, at less cost. In most experimental work stress is laid on the increased yield, but this is not the only promising aspect of the case. We have already referred to the funda-

¹ New Series, vol. ii. p. 165.

mental law that *plants must have all their requirements fulfilled*, the failure of any one requirement setting a limit beyond which crops will not grow. You may improve the soil and the bacteria, increase the food supplies, and bring about the most astonishing changes in conditions, *but so long as anything is left undone the crop is unable to make an adequate response*. Now agricultural investigators aspire to a good deal in the way of control and improvement; but there is one thing that they admit they cannot overcome,—the weather. Short of covering every field with glass, and installing heating and watering systems, we see no way of getting over the effects of cold, wet seasons; of drought combined with cold winds; of lack of sunshine (even glass will not do this), and the other seasonal difficulties that cause so much bother. It is possible to limit the bad effect on the soil so that it ceases when things become favourable, and to some extent the plant can be helped over any check. But the bad effect of bad weather is always the final stumbling-block that has not yet been overcome.

Again, the soil type may set a limit that cannot be passed. The soil may be too stiff or too light for the plant to be completely happy, and consequently, however favourable the season, or however much manure is given, the crop never becomes very heavy.

Any one who takes the trouble to look back over farming magazines of the past fifty years will find abundant instances of discoveries or methods that were to increase vastly the food production of the country. Yet it cannot be said that food production has been vastly increased during the period. This is not because the farmer declines to take up with new ideas, but because the scheme was wrecked as soon as it was carried into the open field. The authors had overlooked one of the fundamental principles of crop production, and had failed to realise that their improvements still left something undone; and this, whatever it happened to be, limited the growth of the crop, and prevented it from taking advantage of any benefits it ought to have obtained. On each farm there is a certain level of crop production beyond which it is exceedingly difficult to get: certainly manuring does not seem to do it. On our own farm, for example, 13 tons of swedes is about as high as we can get, whatever system of manuring is adopted: thus in 1915 the following results were obtained:—

No manure.	Complete artificials.	Dung.	Dung and artificials.
9·6	12·7	12·9	12·9

Neither the climate nor the soil type is quite suitable for turnips, and nothing we can do in other directions quite makes up for the deficiency. The amount of fertilisers used in some of the plots would suffice to give 26 tons of turnips, but the crop is kept down by lack of something else. Until this is got over we waste our money by putting on the extra manure.

But increased crop production does not exhaust the possibility of improvement. Instead of kicking against the pricks, and trying to increase the crop in such cases, a better plan is to try and reduce the cost of production. Here there is abundant scope. A man who already gets 70 bushels of oats per acre at a cost of £4 per acre (not counting rent) would be more likely to benefit from a method that reduced the cost to £3 than by an expensive and risky plan that promised to increase the yield to 90 bushels, at which the crop might be beaten down flat by wind and rain, and prove almost impossible to get in.

When the next lot of field experiments are started after the War, the investigators might well set themselves three questions:—

1. What is the ordinary full yield obtained by good farmers in the district?

2. How can the poorer farmers be helped to bring up their yields to this level?

3. How can the good farmers be helped to get the same yields with greater certainty and at lower costs?

The knowledge already gained by field trials ought to prove extremely helpful in these inquiries.

FURTHER EXPERIMENTS IN CROSSING POTATOES.

By JOHN H. WILSON, D.Sc., F.R.S.E., Lecturer in Agriculture and Rural Economy in the University of St Andrews.

NINE years ago a paper by the present writer appeared in the *Transactions*,¹ under the title, "Experiments in Crossing Potatoes." That communication embodied some of the results of crosses carried out in 1901. Much further crossing has been done, more especially during the past three years, an

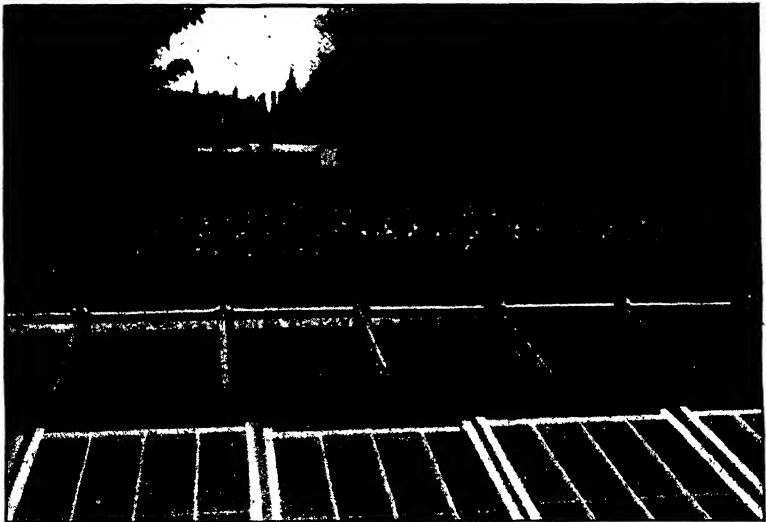


Fig. 13.—*Experimental grounds at St Mary's College. Potatoes planted from pots.*

impetus having been given to the work by the institution of a scheme, promoted by the University of St Andrews, with the assistance of a grant from the Board of Agriculture for Scotland, which has for its object the improvement of potatoes, turnips, and oats. The operations are being carried on in the Agricultural Department of the University. Enclosed grounds within the precincts of St Mary's College (Fig. 13) are used for the growing of experimental plants in their early stages, and

¹ *Trans. High. and Ag. Soc., Fifth Series, vol. xix., 1907, p. 74 et seq.*
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a few acres of farm land, forming part of the property of the University, afford room for the cultivation of the new varieties under field conditions.

The potatoes experimented with have included many named sorts, introduced by various raisers, as well as a number of the writer's older varieties, named and unnamed. In the more recent operations it has been a common practice to utilise as parents plants which have been selected from obviously good races, the pedigrees of the plants having been carefully registered, and the merits of the races determined by comparative methods. The experiments having been extensive, the records have become voluminous. It is impossible in a communication like the present to give an account of more than a portion of the work. The purpose may be served if it deals only with a number of the varieties which have been derived from those described in the previous paper.

THE VARIETIES PREVIOUSLY DESCRIBED.

At the outset, it may be of interest to remark on the fate of the original varieties. If reference be made to the former communication, it will be found that there were four varieties which the writer had reason to hope would prove to be of service to growers. They were respectively named Kate Kennedy, Bejant, Prior, and Rector. The first two had the same parentage, the variety which bore the berry being British Queen, while that which supplied the pollen was Myatt's Kidney.

Kate Kennedy.

Kate Kennedy (Fig. 14, K K) is described as a large kidney, bearing somewhat close resemblance to British Queen, and ripening as soon. The flesh is white. The shaws are of medium height, and they wither early.

In the earlier years of its existence Kate Kennedy gave promise of being a variety of superior merit, the shape and size of the tubers, combined with good cropping power and marked disease resistance, rendering it worthy of note; but in recent years it has belied the promise of its youth, and it is not likely now, at the age of thirteen, to regain its lost prestige. It is interesting to observe that a tendency on the part of the tubers, in certain selected plants at least, to become pear-shaped is one of the features of declension. Reduction in size is a feature that seems in some selections to have become permanent. A striking character exhibited by this variety is the habit of producing many of its tubers deep in the ground, necessitating more than ordinary care and labour

at lifting-time. This peculiarity may well be associated with the conspicuous immunity of the tubers from blight (*Phytophthora*) which the variety displays.

Whatever superior characters Kate Kennedy may possess, it has not been possible to pass them on to progeny, flowers being entirely absent. Any significance which the absence of flowers, and consequently of fruits, may indicate in the matter of constitutional vigour, has been briefly discussed in the previous paper.

While Kate Kennedy is notable in its resistance to blight, it has been found to be susceptible to wart disease. Details

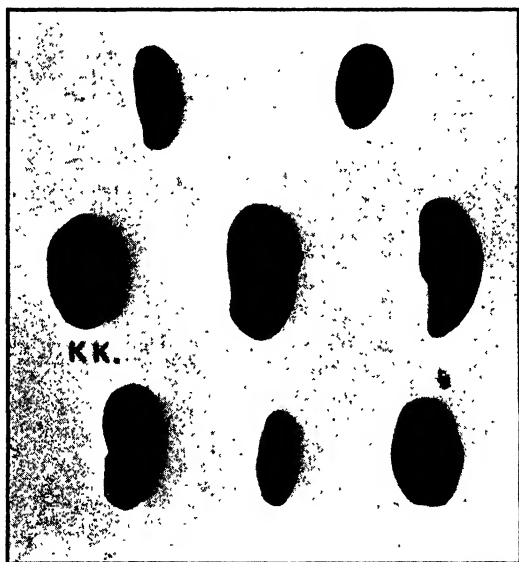


Fig. 14.—Single tubers of Kate Kennedy (K K) and of seven companion varieties.

have been furnished of recent experiments carried out in an infected garden at Tarvit Mill, Cupar, which show that this variety was slightly attacked, while others escaped. At present there is no explanation forthcoming why Kate Kennedy, and Bejant also, should be subject to wart disease, while Rector and Templar prove resistant. Perhaps early sprouting, such as is characteristic of Kate Kennedy and Bejant, may render those varieties more susceptible. It may be mentioned in passing that the writer has found by experiment that wart material, kept perfectly dry in a closed tin box for four years and a half, retained its vitality, causing the disease to appear in susceptible varieties when the sets were dusted with the spore-bearing snuff at planting-time. When kept for six years and a

half its infective power was lost. Tubers seriously affected by wart disease were sent to the writer from Colinsburgh, Fife, in August 1901. One of the specimens is preserved in the Agricultural Museum of St Andrews University.

Bejant.

The companion variety of the above, Bejant (Fig. 15, B), is described in the *Transactions* as an extremely early kidney, with yellow flesh, and the suggestion is made that it might become a useful garden variety. Like Kate Kennedy, it pro-

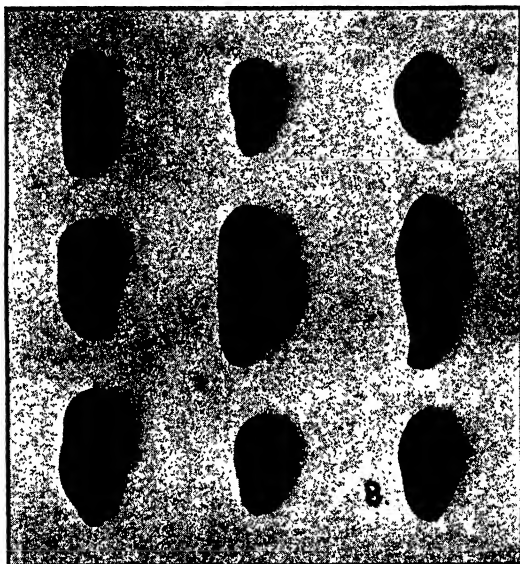


Fig. 15.—Single tubers of *Bejant* (B) and of eight companion varieties.

duced well for several years, but, while it has retained its outward attractiveness, it has become so subject to blight as to be quite untrustworthy. Second growth seems to be rather readily induced. The haulms are from 18 to 24 inches high, and the leaves are glossy. The yellow colour of the flesh (perhaps best described as lemon) is a feature inherited from the pollen parent. The flowers are small, light purple,¹ with the points of the corolla conspicuously white. The colour of the flower is unlike that of either parent, British Queen having white flowers, and Myatt's Kidney pale lilac or mauve.

¹ The term purple, with modifications, is used somewhat loosely in the present pages, and it is quite possible that lavender, heliotrope, violet, &c., might have been more appropriate in certain cases.

Bejant sets no fruit if unaided, but it is readily fertilised by the application of pollen from other varieties. The basal half of the berries is dusky purple. The different colours of the berries of potatoes form a not uninteresting study, varying as they do from plain green to dingy purple, through increasing degrees of stippling, blotching, and shading of the purple.

Prior.

The third of the varieties described in the previous communication was named Prior. It was derived from a cross in

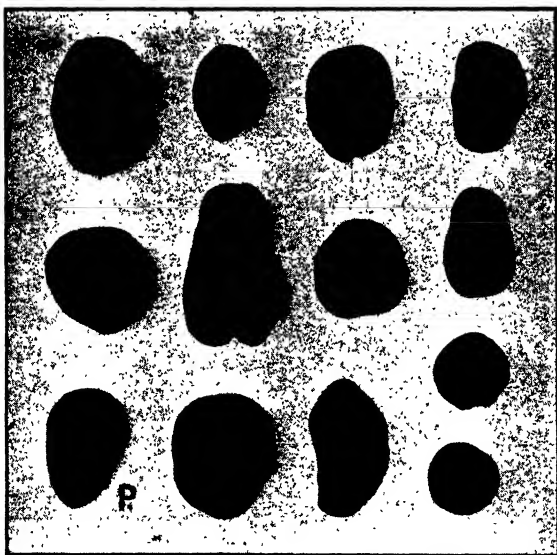


Fig. 16.—Single tubers of *Prior* (P) and of twelve companion varieties.

which the pollen parent was again Myatt's Kidney. The seed parent was a variety which had been sent from the Antipodes, with the reputation of being one of the most reliable grown there. The tubers of this variety are red-skinned, round, rather deep-eyed. The flowers are pale rose-purple, with white-tipped lobes. The tubers of *Prior* (Fig. 16, P) are flat, oval, shallow-eyed, colourless, or with an occasional tinge of pink. The flesh is white, but not pure white. *Prior* has a stronger habit of growth than either *Kate Kennedy* or *Bejant*, and it used to produce large crops of very desirable tubers when cultivated under favourable conditions. It has, however, suffered eclipse, and is no longer grown in quantity.

Although *Prior* bears flowers, it has not been known to set

seed of itself. Good seed has been got by crossing with Myatt's Kidney and with Rector. The berries were much shaded with purple.

Rector.

The last of the varieties described previously is Rector. This variety was one of a few seedlings got from a single berry by using the pollen of the above unidentified red variety to fertilise a flower of Maincrop. The latter is a variety which has held the field for many years. Its tubers are colourless, and the quality is excellent. The flowers are small, rose-purple, with white-pointed corolla-lobes. The colours of the tubers borne by the several seedlings from the crossed seed were

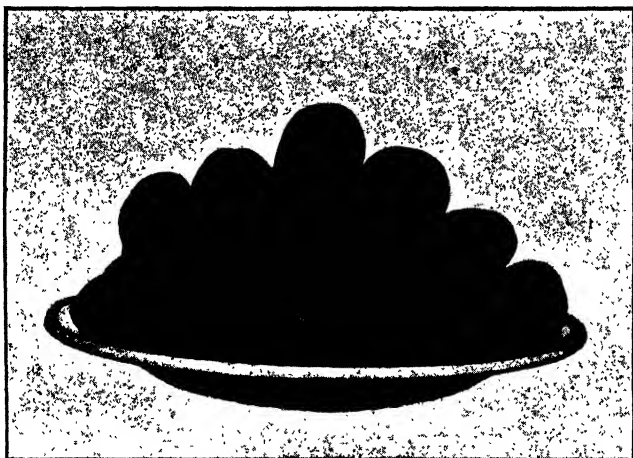


Fig. 17.—*First crop of seedling, the original of Rector, 3 lb. 14 oz.*

purple, red, pinkish, and white, the white being in the minority. A red-tubered seedling bearing very considerable resemblance to the mother plant was outstanding in vigour from the first (Fig. 17), and was by-and-by named Rector. It has now been cultivated for thirteen years. A number of the sister plants of fair promise held on their way for a longer or shorter time, but have all dropped out of the race for distinction.

Rector (Fig. 18) is a red, round potato, with the eyes inclined, under certain conditions, to be a little deep. A stock grown under careful selection and supervision continues to be of very attractive appearance. The tubers are singularly uniform, and not too large. The red colour of the skin is less noticeable after the tubers have been kept in pit for a time. The resistance to blight which characterised Rector in its early days has been

maintained in marked degree, and, as already stated, the variety has been found immune to wart disease. Its red colour has been the chief deterrent to its advance to a place amongst the special favourites. It is still esteemed by growers who appreciate a good keeping palatable potato. In regard to quality, there has been occasion to note with interest and amusement reports which have been published from time to time dealing with Rector as a subject of experiment. The reports from some centres would lead one to imagine that the table merits of Rector had suddenly become decidedly inferior, while those from others point to continued excellence. When the variety was grown for a succession of years at the same place it would be found to be highly praised one year and only faintly praised the next. Such records have to be received



Fig. 18.—*Rector*.

with due reserve. In some cases where deterioration has been noted it has been ascertained that the manurial treatment has not been in accordance with the requirements of the crop. The question of quality is a complex one. Much depends not only on the use of stimulating fertilisers, but on the peculiarities of soil, climate, and season. It is hard to find a variety which is so constituted as to be a success everywhere and under all conditions.

Progeny of the Older Varieties.

In the subsequent notes it is proposed to recount results obtained by crossing in which the above varieties were used as parents. In these experiments comparatively little attempt has been made to elicit further illustration of theoretical principles. In the previous notes some suggestions were given pointing to characters which were probably Mendelian. It was shown, as other raisers have also noted, that varieties with white—that is, uncoloured—tubers were to be counted upon as fairly certain to yield progeny with tubers having a similar character. Seeing that coloured tubers are not in vogue, much of the crossing with commercial objects in view has been done with that useful fact in mind. To carry out experiments in heredity satisfactorily with potatoes it is necessary to grow a large number of plants which are of no use to the farmer.

Circumstances have not permitted of that course of action being very consistently pursued. In any case, so far at all events as the more recent work has been concerned, there seemed to be a very fair prospect of success when a large number of crosses were made and all the inferior seedlings eliminated at as early a stage of their existence as was practicable. The tendency to predict immediate and startling results in potato-raising by applying Mendelian methods is liable to become modified by experience. Although it does not appear that many of the varieties at present making headway in the struggle for supremacy have been originated by employing those methods, it is

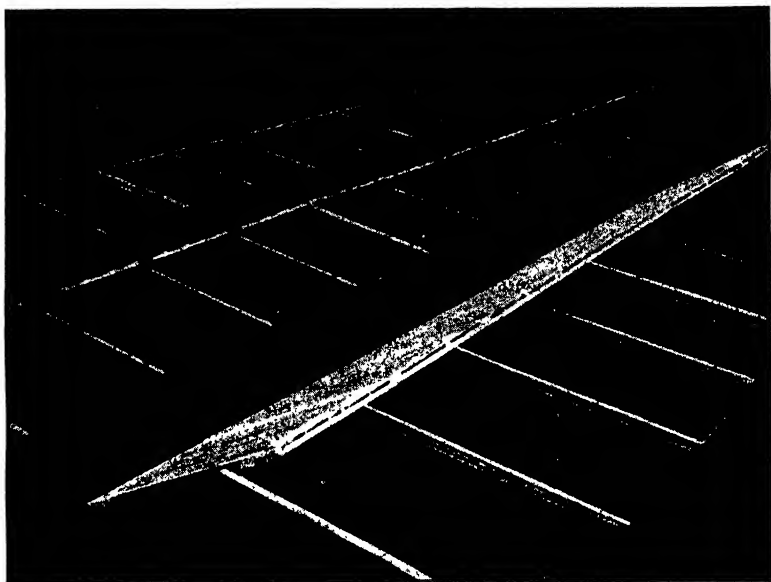


Fig. 19.—*Frames protecting seedling potatoes.*

nevertheless to be expected that more and more attention will be paid to the recognition of heritable factors and to their efficacy in the hybridist's operations. In the following pages the numerical method of reaching those factors will be exemplified in respect of such points as segregation of tuber and flower coloration, but it may be stated frankly that instances are given which are difficult to interpret. Similar difficulties have been encountered by other observers.

The tuber of the potato is a structure as likely as any other part of the plant to show distinctive heritable characters, but when once a desirable variety is got it is propagated by vegetative means, all the tubers produced in the future being

practically portions of the original tuber or tubers. The tuber which the raiser regards as an ideal, and makes his best endeavour to evolve, is colourless, shallow-eyed, moderately large, firm-fleshed, disease-resistant, and of good cooking quality; and it is one of many borne by short stolons or runners close to the base of the haulms. This aggregate of characters, exhibited by the few, is not reached at a bound, but through a long course of selection which has meanwhile



Fig 20 — *Fibrous plant, an inferior type*

been carried out with reference to other characters as well, such as strength and habit of shaw, comparative earliness, and keeping power. After all is done, further improvement of a desirable strain may be rendered impossible by failure to produce flowers

Seedlings from Rector.

It is to be noted that Rector bears fruit freely by self-fertilisation. A particularly large crop was borne in 1904.

Seeds from many berries were mixed and 100 sown in spring of 1905. Seventy-six of the seedlings were planted out in summer of that year. When lifted in the autumn the tubers of the several plants were seen to present much diversity in colour, as the following list shows: in 7 plants bright red, 11 red, 12 light red, 7 pink, 18 pinkish, 1 pinkish with red eyes, 7 white with pale pink eyes, and 13 white. If the last two numbers be taken to represent white varieties, and the



Fig. 21.—*Second growth, a bad feature.*

other numbers to represent coloured varieties, the proportion of coloured to white is 56 : 20, a close approximation to the Mendelian ratio, 3 : 1.

Twenty-one of the seedlings were selected for further planting in 1906, of which 15 were coloured and 6 white. When harvested, only two were considered worthy of retention, a white and one of the "red" lot. The former disappeared before long. The latter was kept in stock until last autumn, but it was used as a parent for further experiment in crossing in 1911.

Truce.

It is necessary at this juncture to describe a variety which has figured largely as a pollen parent in many of the later experiments. For convenience it may be designated *Truce*. The mother of this potent variety was an unnamed sister plant of *Rector*, a robust plant with deep-eyed or somewhat rough, flat, oval tubers, white at lifting, but inclined to develop a tinge of pink in store. The flowers might be described as white with rose centres. It was discarded about 1908. Four years previously, however, this variety bore a berry, presumably by self-pollination. The seeds were sown in 1905, and 31 seedlings were planted out. Two of the seedlings died. Of



Fig. 22.—Single tubers of *Truce* (T) and of two other varieties, each 1 lb., the first year from the berry.

the 29 left, 21 bore white tubers, and the remaining 8, white tubers with varying shades of pink. In one of them the pink was disposed in patches. The series as a whole presented remarkable uniformity, and when compared with the seedlings from the "selfed" seed of the red-skinned companion plant, *Rector*, it was obvious that the white character conformed to the expectations based on Mendel's observations. Of the 13 plants kept for further study, 10 were white, and 3 white with a very faint tinge of pink. One of the white plants made particularly good growth during the first year of its life. It produced 23 tubers, having a total weight of a little over 5 lb., the largest tuber weighing 1 lb. (Fig. 22, T), and measuring 5 inches in length. Three of the tubers were affected with blight. This variety, on account of the likelihood of its being fixed in type, and also on account of its pristine

vigour, was marked for preference as a parent. In course of time it displayed great pollen-bearing power, and its pollen has been much used. Truce, as it is now called, has retained its vigour of constitution unimpaired up to the present date. Its tubers unfortunately are not perfect in shape, being sometimes a little coarse. At its best the tubers are not unlike those of Rector, but without the colour. The flowers are white, and produced in great abundance. Berries are borne in clusters.

Student.

It falls to be mentioned here that a sister plant of Truce has been kept under observation up to the present time, and the stock has recently been put into cultivation under the name Student. This variety is a heavy cropper, and of excellent quality. The tubers are oval, white, and of good size. The flowers are rose-purple with white. There is good reason to hope that Student will find a place amongst the favourites.

Rector Seedling × Truce.

Notes may be given of an experiment in which the "red"-skinned seedling out of Rector, mentioned above—the last of its race—was fertilised by pollen of Truce. The relationship of the parents corresponded to cousinship, the mother plants being sisters. The crossed berry was secured in 1911, and the seed was sown in 1912. The seedlings, planted from pots, numbered 48, and 46 plants were harvested, 24 having white tubers and 22 coloured, that is, varying shades of pink and red. Only three plants were considered good enough for further cultivation, two with white tubers and one with red. The following year they too, having failed to attain the desired standard, were discarded, leaving no representative of the race.

Maincrop × Rector.

It was thought probable that good results would be got by blending the blood of Maincrop with that of its own progeny. It was accordingly fertilised by the pollen of Rector, which, as has been stated, was the outcome of crossing Maincrop with a red unnamed variety. The seed from a single berry was sown, and 61 seedlings appeared. Of these, 33 were planted in the open ground. The variation in the colour of the tubers was as follows: 8 plants purple, 2 light purple, 1 red, 2 light red, 2 pink, and 18 white (1 with pink eyes)—that is, 15 coloured and 18 white. Next season 16 of the foregoing plants were planted, 9 white and 7 coloured. In course of time 6 of

the 16 were selected and sent out for field trial. They, along with many other varieties representing a very considerable number of crosses, were decimated by sudden and severe frost. One of the set saved has been grown in sufficient quantity to test its merits. The tubers are shapely, round, colourless, and fairly large; the flesh dull white or yellowish. The habit is robust, the stems erect and strong. The flowers are white. For some reason at present unexplained a number of the tubers, although to all appearance quite sound when planted, in certain seasons do not vegetate freely, thus causing irregularity in the lines.

Seed of another berry of the same cross was sown. Of 31 seedlings, 21 were grown to produce tubers. Their colours were respectively: 1 purple, 3 light purple, 3 light red, 1 pale pink with red eyes, 1 white with purple patches, 3 white with pink tinge, 1 white with pink eyes, and 8 white. Six of the plants, five of which bore white tubers and one purple tubers, were retained for cultivation, but they also succumbed to frost before they had been sufficiently approved for general distribution.

Up-to-Date × *Rector*.

Bishop.

A good deal of interest is attached to an experiment in which *Up-to-Date* appeared. This variety was brought to produce fruit readily enough by using pollen of *Rector*. The seeds were few and only moderately good, but seeds got by crossing *Up-to-Date* with several other pollen parents were in each case also fewer than usual. Twelve seedlings were planted in 1906. When harvested, the colours of the tubers of the respective plants were noted to be: 1 plant light red, 1 pink, 2 pink-eyed, and 8 white. Three of the plants showed some disease. It is a very common occurrence to find seedlings in their first year more or less diseased. The shaws in most cases grew very vigorously, measuring at lifting-time 3 feet 6 inches to 5 feet. Six plants were kept, all having colourless tubers, with the exception of one with pink eyes. All bore white flowers, except one, the flowers of which were deep rose-purple. Two only of the six were preserved for further trial. One of them was the purple-flowered variety. This variety has been named *Bishop*. Its tubers are oval, colourless; the flesh pale yellow. *Bishop* has been grown in fair quantity in several districts, and has proved to be worthy of extended cultivation. It is not resistant to blight when attack is severe, in that respect revealing vulnerability which in recent times at all events is not unknown in the mother plant.

The companion plant out of Up-to-Date, as already stated, was white-flowered. In its first year from the seed it gave promise of being robust, the crop consisting of 18 tubers, weighing in all $4\frac{1}{2}$ lb., as against the crop of the seedling ultimately named Bishop, the first crop of which consisted of 10 tubers weighing only $2\frac{1}{2}$ lb. It may be mentioned that one of the seedlings referred to as having pink eyes also bore a crop weighing $4\frac{1}{2}$ lb., but 8 tubers out of the crop of 13 were diseased. No disease appeared in the first crop of either Bishop or the variety at present under discussion. The tubers of this variety are large, oval, and of good shape, the flesh dull white, and the quality fine. This variety, after having gone through the same course of selection as Bishop, was sent out for further trial.

Up-to-Date \times *Myatt's Kidney*.

Up-to-Date was also crossed with pollen from Myatt's Kidney. At least 31 seedlings appeared, and of these 26 were planted. Four of them died. In the middle of October notes were made of the length and the period of decay of the haulms of 17 of the plants, to the following effect: 1, 6 ft.; 3, 5 ft.; 1, 4 ft. 9 in.; 2, 4 ft. 6 in.; 2, 4 ft. 3 in.; 2, 4 ft. (1 dead); 1, 3 ft. 6 in. (dead); 1, 2 ft. (dead); 1, 1 ft. 6 in. (dead); 3, quite withered. The proportion of late to early was thus 10:7. The remaining 5 were too weak to afford reliable observations. When lifted the 22 plants were found to have produced without exception colourless tubers. Only four or five of the varieties were free from disease. The colour of the flesh of 11 was not ascertained, 5 of the others were white, 1 was deep lemon, 3 lemon, and 2 pale lemon.

Ten of the seedlings were selected for further planting, and these included all the lemon-fleshed varieties. The flowers of the latter were coloured as follows: 1 deep purple, 1 mauve purple, 1 very pale rose-purple, 1 very pale lilac (almost white), and 1 white. In one the buds did not open. The four white-fleshed varieties bore flowers with the following colours: 1 mauve, 1 rose-purple with white lobes, 1 very pale lilac, and 1 white. Owing to their marked degeneration the whole of the varieties dropped out of cultivation at the end of the second year.

Up-to-Date \times *White-tubered Sister Plant of Rector*.

Further crossing of Up-to-Date was accomplished by using pollen of the plant already described as that from which Truce was derived—viz., the sister plant of Rector bearing colourless tubers. The dates of crossing, seed-sowing, and cultivation of

the seedlings correspond to those of the above experiments with Up-to-Date. Twenty-five seedlings were planted. In autumn all were seen to have produced colourless tubers. Twenty-one of the varieties were immediately discarded. Of the four varieties left, only one had diseased tubers—eight of the tubers in question being affected, while six were free. The fourteen tubers weighed 6 lb. Two of the varieties had white flowers and one variety purple, and the fourth bore buds which fell unopened. As with the foregoing, none of the varieties were kept to plant after the second year of their existence.

Prior × Rector.

As already remarked, Prior bore fruit when pollinated from Rector. The single berry secured was large, and yielded 110 seeds. It is possible that the whole of them would have germinated if the seed-pan had been allowed to stand long enough before being emptied out. The braird was unusually uniform. Here, as in most other groups of seedlings, it was possible at an early stage to discern distinct types. In one the leaves were pale-green and the stems devoid of "colour," while in the other the foliage was dark-green and the stems tinged with red. The former are characters which indicate in a general way prospects of the production of colourless tubers. At the end of May, 47 of the seedlings were planted in the open ground. Three of them succumbed. The colours of the tubers of the forty-four plants left were as follows: 8 purple, 2 light purple, 4 red, 4 light red, 1 reddish with pink eyes, 4 pink of different shades, 2 pink-eyed white, and 19 white. If the pink-eyed white varieties are classed with the white, the proportion of coloured to white is 23:21. In one of the colourless varieties, the flesh of which was white, there occurred a number of violet marks or blotches. This is a peculiarity which appears unexpectedly now and then (Fig. 23). The greatest development of internal violet coloration

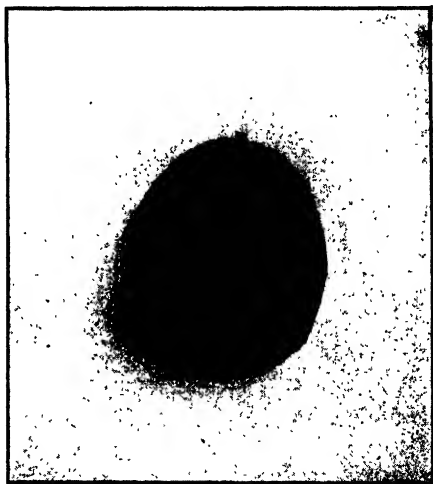


Fig. 23.—Violet coloration of the flesh of the tuber.

tion is found in the so-called "Black" varieties, where in many of the tubers the whole of the flesh is coloured.

Seventeen plants were selected for further planting. Of these, 13 bore white flowers and 3 coloured. The buds of one failed to expand. The following year only 6 plants were retained for cultivation—viz., 2 with white tubers and 4 with more or less coloured tubers. In the succeeding season the number was reduced to 3—1 white and 2 coloured.

All three varieties have been kept in stock up till the present time. The white-tubered variety has not been named. The tubers are flat oval, with pure white flesh, and the flowers are white. The quality is fine. A year or two ago this variety was sent out in fair quantity to be tested on a more extensive scale than experimental grounds admit of; but it unfortunately became mixed with other varieties, and the stock had to be destroyed. The new stock, originated from a small number of tubers, is not yet so attractive as the old one was.

Pict.

The two coloured varieties have been named respectively *Pict* and *Celt*. The tubers of *Pict* are oval, light pink, white-fleshed. The flowers are white. This variety has been fairly extensively grown. It, too, suffered a set-back by being mixed after having undergone a period of selection. There is good reason to believe that it is resistant to wart disease.

Celt.

The tubers of the other coloured variety, namely, *Celt*, are shapely, flattened-round, pinkish, with darker pink in the eyes. The flesh is white, and although it lacks density it cooks well. The haulms are very strong. The flowers are large and white. *Celt* has been grown in several centres, and has always proved to be a heavy cropper. It is doubtful if it will become a general purpose variety, but there may be a future for it somewhere in distant parts if not at home.

Scottish Triumph × *Rector*.

The well-known variety, *Scottish Triumph*, bore fruit when pollinated from *Rector*. Four berries were got, and all contained good seed. The seed was thrown together, and part of it sown. The seedlings, numbering 96, were specially promising from the first, and in many cases produced tubers quite early in life. However, only half of them were potted and planted. Three died after planting. When taken up in

the autumn the distribution of the tuber-coloration amongst the 45 plants was as follows: 7 red, 6 light red, 1 pink-eyed reddish, 3 pink-eyed white, and 28 white. In course of time the numbers were by successive reduction brought down to three, which are still in existence. One of the discarded plants bore crossed seed which has produced progeny of greater merit than the mother plant, the tubers of which, it may be said, were flat, oval, colourless, the flesh whitish, and the flowers very pale rose-purple with white points.

Cadet.

One of the varieties still being grown is unnamed: the other has been designated *Cadet*. They resemble each other in bearing white flowers. The tubers in both are oval, flat, colourless, the flesh white. *Cadet* ripens its crop earlier, and the tubers are somewhat longer in shape. It may be held as certain that *Cadet* is not immune to wart disease. No experiments in connection with this disease have been carried out with the unnamed variety. In most seasons this latter variety has been described as very fine, the shape being extolled; but in some seasons the appreciation has not been so high.

Mac.

The remaining variety of this series to be mentioned, named *Mac*, differs distinctly from its relatives in many points. The tubers are round, somewhat deep-eyed, red-skinned, and resemble those of the pollen parent closely. The flesh is white. The flowers are large, bright purple. The habit of *Mac* is good; the shaws strong, ripening somewhat late. Under generous treatment the crop is very heavy, the tubers being inclined to be large. A good deal of blight occurs in seasons when it is prevalent. An interesting instance of colour variation was noticed in last year's stock. In a "shaw" of 5 tubers 2 of them were the usual red, and 3 were variegated, owing to the occurrence of white patches.

Bejant × *Rector*.

In expectation of obtaining interesting results, *Bejant* was pollinated from *Rector*. It will be remembered that *Bejant* was the outcome of a cross between *British Queen* and *Myatt's Kidney*, and *Rector* a cross between *Maincrop* and an unnamed red variety. Three crossed berries were secured, and the seed yielded by two of them was mixed and sown in the usual manner under glass. A comparatively small number of seeds germinated, and ultimately 20 seedlings were planted out. Two

failed to reach the tuber-bearing stage. The tubers of the remaining 18 were coloured as follows: 2 light purple, 1 purplish red, 4 red, 2 light red, 1 pinkish, and 8 white, being 10 coloured as against 8 white. The colour of the flesh in 7 of the best plants was noted, 3 having lemon flesh, 3 pale lemon, and 1 white. The tubers of one of the plants with colourless skin and lemon flesh weighed $3\frac{1}{2}$ lb., the largest tuber weighing $1\frac{1}{4}$ lb. and measuring 5 inches in length. Not a few of the plants were attacked by blight. Notes of the appearance of the haulms of 8 plants at lifting-time were made. In 1 they were very robust, in 3 strong, in 1 moderate, and in 3 short and quite withered. At the end of the second year 11 of the plants were discarded. Later, the stock of three of the varieties was destroyed, and that of the four remaining was put through a process of selection for six years, when another two dropped out. Crossed seed, however, from one of the latter was got, and one of the seedlings is being propagated.

One of the two varieties retained has not been named. Its tubers are round, somewhat flattened, and lemon-fleshed. The flowers are large, very pale rose-purple with white lobes. The stock kept is small, and is preserved chiefly for comparison with progeny which are undergoing selection. One of the derivatives is a cross with Truce.

Friar.

The other of the two remaining varieties has been named Friar. The tubers are distinctly round, rough-skinned, red, and not large. The flesh is fairly deep lemon. The flowers are rose-purple. It is interesting to note that the red colour of the skin is virtually the same as that of the seed parent, Rector, and also of the pollen-bearing grandparent, the red variety from the Antipodes. The yellow colour of the flesh is handed down from the seed parent, Bejant, and, in the second remove, from the pollen parent, Myatt's Kidney.

What seems to be a decided case of sporting occurred in this variety. This was noticed at harvest in 1914. The new type was markedly inferior. The haulms were open or spreading, dark-green and stunted, with the dead leaves clinging to the branches. In the normal type the stems were erect, 6 inches higher, lighter green, with the leaves all shed. The crop of the former was poor, with many small. It is impossible to see how the conditions of cultivation could have caused the differences observable.

Rector × Myatt's Kidney.

Two berries were got from Rector by crossing with Myatt's Kidney in 1905. The seeds from the two berries were mixed and sown in 1906. Thirty-three seedlings appeared, and 24

were potted and planted out. One died after being planted. The tubers of the 23 remaining were coloured as follows: 3 purple, 3 light purple, 1 light red, 1 white with pink eyes, and 15 white. The flesh of 11 of the seedlings was noted: 2 deep lemon, 2 lemon, 1 pale lemon, 1 very pale lemon, 2 whitish, 2 white, 1 pure white. Only three of the plants in question were quite free from disease. Eight of the plants were retained for further planting. When they flowered the colours were found to be: 1 very large mauve, 1 light purple with white points, 2 pale mauve (becoming white ultimately), 3 white, 1 pure white. At selecting in 1907, 6 were destroyed, leaving 2 which were planted in 1908. One of them was very early, the other late. The former, a white-flowered variety with yellow-fleshed tubers, continued to be grown until 1912, when it was discarded. The latter has been carefully preserved, and is now known as *Templar*.

Templar.

The tubers (Fig. 24) are finely shaped, flattened oval, colourless; the flesh dull white. The quality is very good. The



Fig. 24.—Tubers of one plant of *Templar*.

haulms are strong, and fairly late in ripening. The flowers are white, and produced in great abundance, the field having a very attractive appearance when covered with bloom.

A character of the highest importance in *Templar* is its re-

markable resistance to blight (*Phytophthora*). Templar was one of the three seedlings that in the first year (1906) showed no disease. In the following two years it would seem that a trace of disease had been noticed. Whether that was so or not, no further records of blight are given from the experimental grounds until 1914. In that year no disease was found at lifting, but when the stock was examined in winter, one or two tubers out of a large number were found to be slightly affected. In 1915, again, while no disease was traceable at the lifting, a few developed blight in the sacks. It has often been remarked that in the fields when other varieties in close proximity to Templar were seriously diseased it remained immune. Templar does not produce exceedingly large tubers, but under average conditions the crop is a heavy one, and the tubers of a very useful size. The sets should be planted somewhat wide apart in the drill. As already stated, experiments have proved that Templar is resistant to wart disease. It has not been known to be affected with "sprain," and it has been found to be free from scab where other varieties have been seriously attacked.

Another point in favour of Templar has been brought to the writer's notice by a skilled gardener in the East of Fife. Last year he planted unprepared sets in the first week of April. In July, when the plants were still in a state of vigorous growth, a number of them were dug up by mistake. The tubers were seen to be of quite usable size, and when cooked the quality was found to be excellent. This accommodating behaviour on the part of Templar should not be forgotten. It would be highly interesting if it could be shown that the "early" traits of the pollen parent, Myatt's Kidney, are impressed on Templar in such a way as to render the crop of marketable value when still immature.

Templar × *Truce*.

A great deal of multiple crossing has been carried out with the above described varieties, and pedigrees of a very interesting kind have been built up. These varieties include Bishop, Celt, Cadet, Mac, and Templar. The progeny of several of the new varieties have also been subjected to further crossing. Interesting as many of the new races are, it is expedient to confine attention to the family tree, of which Templar is the stem.

A cross was effected with Templar as seed parent and Truce as pollen parent. The seed from two out of four crossed berries was mixed and sown together. The date of sowing was later than usual, being in the middle of May. Although the seed was not at all good in appearance, a large number of seedlings braided in course of time. Fifty-one were planted in the ground towards the end of July, and twenty-six were kept at lifting. The tubers of the plants kept were all colourless,

white-fleshed. No disease was seen in the first crop of tubers. By-and-by it was observed that the flowers of all the twenty-six varieties were white. It is interesting to recall that the flowers of both parent plants are white.

Three of the series have survived the ordeal of selection. Two of them bearing close resemblance to Templar have been propagated in fair quantity. One of these kept quite free from blight during the first two years of its existence, that is, in 1912 and 1913. When lifted in 1914, and also in 1915, no disease was noticed in the tubers, but, as with Templar, a little appeared in the sacks in store. This is by no means the only case where disease has developed amongst the stored potatoes during the past winter—in fact the trouble in this respect has been entirely unprecedented.

Seed from two berries out of five of the same origin, but from crossing carried out a few days later than the above, was sown after having lain over a year in the packets. In this case the seed from each packet was sown by itself. One of the berries contained 127 small pale yellow seeds. One hundred seeds were sown in the first week of March 1913, and 65 seedlings were pricked off. Fifty-seven were planted in the open ground, and notes have been kept of 13 of them. All bore colourless tubers, except one which was tinged with pink. The flesh of 2 was pale lemon, that of the rest white. No disease appeared in the tubers of the first year. The flowers of the 13 plants under observation were white. Three of the series were kept to plant in 1915. Two of them showed no disease when lifted, but in both cases it has developed in store.

The other berry contained 174 seeds, which were pale yellow and unusually small. All were sown, and 113 of the seedlings braided before the seed-pan was emptied. Forty-five were planted, and notes were made of 15 of them at harvest. As in the companion series, the tubers of all were colourless, with the exception of one, which was pinkish; and the flesh of two was pale lemon. No disease was present in the first-year tubers. Again the flowers of all were white. Ten of the varieties were planted last year, and stock has been kept of them all. Although most had a very good record in their early stages, it remains to be seen if any of them will prove ultimately to be absolutely resistant to blight.

With the object of helping the potato growers in Australia to get new resistant varieties, crossed seed was sent to the several States of the Commonwealth. The Department of Agriculture of Victoria has published the results of the experiments carried out in that State. Great care has been bestowed on the work of growing the varieties, and very elaborate records made of their characters. Space may be

found here for a digest of the results with one only of the series—viz., that sent out as No. 139. The berry from which the seed was taken was one of the five from which the two series just described originated. In the Australian records the parentage is stated as follows: Maincrop (2), New Zealand variety (2), Myatt's Kidney. If put in pedigree form, it appears thus:—

<u>Maincrop × New Zealand variety</u>		<u>Maincrop × New Zealand variety</u>	
<u>Rector × Myatt's Kidney</u>		<u>Unnamed (self)</u>	
<u>Templar</u>		<u>Truce</u>	
139			

The seed was sown in pots on 23rd February, and on 6th April the seedlings were planted in a garden plot. Frost and drought checked the growth considerably. The haulms were matured by 1st June, and the crop was lifted on 27th June. The tubers were very small. On 21st November the tubers were planted, and they were watered artificially when the weather was dry. They thrived exceedingly well. The characters of the new crop were tabulated. Thirty-five plants of No. 139 were grown. The percentage of the yellow-fleshed was 20. In respect of time of maturity, 48·6 per cent were very early or early, 22·8 per cent medium early or midsummer, and 28·6 per cent late. With regard to shape and colour of the tubers, 37·1 per cent were kidney-shaped, and, as far as observations could be made, 3 per cent were pink-skinned. The length of the stolons also received notice—77·3 per cent having short stolons, 8·5 medium, and 14·2 long stolons.

The returns for the second season's planting, for which the writer is indebted to Dr S. S. Cameron, Director of Agriculture, show that many of the varieties of the No. 139 series continue to promise well as croppers. The largest crop, however, was not so good as one borne by a variety from another of the crosses sent to the Department, having the pedigree (Bejant × Rector) × Truce, the weight of which was 11 tons 2 cwt. This cross is referred to in the paragraph dealing with Bejant × Rector (p. 50).

Concluding Remarks.

Most of the varieties which have been crossed with Truce have been otherwise experimented with, and intercrossing of desirable derivatives has been carried out to a very considerable extent; but for the time being the results of those crosses, and of scores of crosses in other lines, must await elaboration. When that is done, further light may be shed on the many problems the raiser desires to solve.

The general impression left on the mind of the reader of the foregoing notes will doubtless be that the raising of new varieties of potatoes is not a mere pastime. It is a widely accepted belief that, pending the genesis of the variety that will withstand the onslaught of *Phytophthora infestans* without turning a hair, and be in all other respects ideal, some one must continue to sow potato seed and select from a multitude of seedlings a precious and promising few. This labour of love is not of recent initiation. To hark back no farther than 1800, one reads the following observations made at that date by the worthy minister of Markinch—a place to be afterwards very favourably known in connection with the subject—"Seed has been sometimes produced from the apple. . . . This practice, it has been alleged, is necessary to prevent degeneracy and a diminution of the crop." In 1836 Messrs Lawson & Son published a list of 146 named varieties. The great majority of the varieties bore coloured tubers. A few of the names are a memory, the rest are long forgotten. In the *Transactions* of the Highland and Agricultural Society, issued in 1870, Mr William Paterson, the raiser of the famous variety, Victoria, expressed the opinion "that the potato plant was only designed to serve its generation, and that without a constant and successive renewal from the plum or apple it was quite probable that this most valuable esculent might be lost altogether." Commencing operations of seed-saving in 1853, by 1860 he had about 100 tons from which to select. From 1860 to 1863 his stock amounted to about 1000 tons, made up of about twenty oval and round varieties and sixteen varieties of kidneys. It is likely that all have disappeared from cultivation. "It may very well be conceived," says Mr Paterson, "that the trouble and anxiety I entailed upon myself was, comparatively speaking, enormous." His suggestion is: "Should my system of propagation be carried out hereafter, I would recommend that it be done by Government or some public body, as it is an experiment far too costly for an individual in ordinary circumstances, even although potato plums are now to be had in almost any district from my seedlings."

In a paper published in 1909, a noted hybridist in the south of Scotland speaks lightly of having raised 13,000 seedlings, and since then he has added very largely to that number. Burbank, the Californian hybridist, is credited with having made the somewhat discouraging remark that "not more than one new variety of potato in five thousand should be named and disseminated." When, out of the untold numbers of seedlings which are being grown in this country and elsewhere, the perfect potato is evolved, an end will be put to a pursuit which, if calling for the expenditure of much energy and no little skill, is not without fascination and human interest.

SOME COMMON GRASSES AND HOW TO KNOW THEM.

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THE purpose of this paper is to describe the best grasses so that they can be recognised and identified. Along with the best grasses some others are described for special or comparative reasons. The arrangement of the paper is as follows: In the first part a description is given of the various parts of a grass,—root, stem, leaf, flower, fruit, seed,—and the terms used for descriptive purposes are defined. One of the difficulties in reading the books is that—especially as regards flower, fruit, and seed—the same part may be known by two and three different names, one book using one name and another book another, while at the same time the common name used is often scientifically and botanically incorrect. An endeavour is made here to give such definitions, and to quote side by side the various terms applied to the same thing, as to be helpful to one who has not the opportunity to study the grasses under the guidance of a teacher. The second part of the paper is devoted to a detailed description of each grass named, followed by keys in tabular form which may be aids in running a grass down and separating it from its neighbours. The third and concluding part of the paper deals with the identification of the grass “seeds.” It is clear that in the second and concluding parts of the paper numerous recurring terms must be used, and the reader getting confused over any of the terms should refer back to the first part of the paper, where the term or terms are explained.

GRASSES (*GRAMINEÆ*).

Grasses form one of the largest and most widespread of Natural Orders of plants. They are chiefly herbaceous; abroad, the sugar-cane and the bamboo reach a considerable size. The chief characteristics which separate grasses from their nearest plant allies are—

(1) The arrangement of the leaves: each leaf comes off the stem at a different level from the next one, and in the transverse direction each is distant from its nearest neighbour by one-half of the circumference of the stem—*i.e.*, if we look along the stem the leaves are in two rows.

(2) The leaves are made up of a sheath, a ligule, and an elongated narrow blade.

(3) The leaf-sheath is split down one side (there are a few exceptions).

(4) The stem is hollow except at the places where the leaves come off (nodes), which are solid.

(5) The stem is round and not triangular.

(6) The embryo lies at the base of the seed, on one side, and outside the reserve of food material (endosperm).

LENGTH OF LIFE OF GRASSES.

Grasses are either annuals, biennials, or perennials. An annual grass is one which completes its life in one year; the seed germinates, the vegetative organs—root, stem, leaf—are produced, then flowers, fruit, and seed, and the plant dies. If the grass be biennial, in its first year it produces its vegetative organs, and in the second season flowers and seed, and dies. A perennial grass is one which lives on for several or many years; it does not overseed, else it may lose perennial character. A very characteristic mark of a perennial grass is the presence of some sort of creeping or underground stem; such a structure is a storing organ; at the expense of the store of food material new shoots and roots can be developed below ground, and also aerial leaf-bearing shoots and flower-bearing shoots.

The grasses mentioned in this paper may be arranged under the heading Annual, Biennial, or Perennial. It will be observed that the same grass may appear in more than one of these three divisions, this variation depending on the soil and other conditions in which the grass is grown.

Annual.

Annual Meadow Grass (*Poa annua*).

Perennial or Meadow Rye (*Lolium perenne*).

Biennial.

Italian Rye (*Lolium italicum*).

Perennial.

Perennial Rye (*Lolium perenne*).

Meadow Fescue (*Festuca pratensis*).

Cocksfoot (*Dactylis glomerata*).

Crested Dogstail (*Cynosurus cristatus*).

Timothy or Catstail (*Phleum pratense*).

Meadow Foxtail (*Alopecurus pratensis*).
 Tall Oat (*Arrhenatherum avenaceum*) (*Avena elatior*).
 Golden Oat (*Avena flavescens*).
 Rough-stalked Meadow Grass (*Poa trivialis*).
 Smooth-stalked Meadow Grass (*Poa pratensis*).
 Sweet Vernal Grass (*Anthoxanthum odoratum*).
 Yorkshire Fog (*Holcus lanatus*).
 Creeping Soft Grass (*Holcus mollis*).
 Couch (*Agropyrum* (*Triticum*) *repens*).
 Wavy Hair Grass (*Aira flexuosa*).

The perennial grasses vary in habit of growth—e.g., in the above list the tufted habit, say of Cocksfoot (*Dactylis glomerata*) is very different from the creeping habit of Couch (*Agropyrum repens*). Whether a grass be tufted or creeping depends on the behaviour of the branches given off from the underground part of the stem. The place for a bud is in the axil of a leaf—i.e., in the angle between the leaf and the stem from which the leaf arises. Now the buds in grasses arise in the leaf-axil at the base of the sheath of the leaf. The branch that develops from the bud appears outside—that is, does not continue to remain hidden by the leaf-sheath—either by growing upwards into the air without tearing the sheath, or it tears the sheath by growing through it and extending or creeping horizontally in the soil. In the former case the grass is a tufted one; in the latter it has a creeping habit. In a light soil such a creeping underground stem may make rapid progress in length, hence grasses with this creeping habit very marked are sometimes known as quickens (quick=alive). These underground branches or stems give off roots here and there as they grow through the soil; also having buds on them these underground stems are able to give off daughter branches, and so to continue the growth in length of the creeping stem when the parent itself has, after a time, bent upwards into the air to work as an aerial shoot with green leaves. As regards habit of growth, the grasses named in this paper may be distinguished thus:

Tufted Grasses.

Perennial Rye.	Crested Dogstail.
Italian Rye.	Timothy.
Meadow Fescue.	Tall Oat.
Cocksfoot.	Golden Oat Grass.

Timothy in dry conditions is bulbous, a swelling being found at the base of the aerial stems.

Tall Oat Grass may also have very short underground branches, but a more important matter is the so-called bulbous

condition of this grass known by the name *Arrhenatherum avenaceum* var. *bulbosum*, or Pearl Grass. Certain parts (internodes) at the base of the stems swell into tuber or corm-like growths. Each of these swellings contains a store of reserve laid past in it by the plant. The above-ground parts suffer, of course, by their manufactured food being drained away to an underground swollen portion, of which for feeding purposes no use can be made, while at the same time each of the swollen structures is able to give rise to a new plant.

Golden Oat might appear in the list of Creeping Grasses, but the creeping branches are so short that the aerial shoots are not wide apart.

Creeping Grasses.

Meadow Foxtail.
Rough-stalked Meadow Grass.
Smooth-stalked Meadow Grass.
Sweet Vernal.
Yorkshire Fog.
Creeping Soft Grass.
Couch.

Rough-stalked Meadow Grass, which might also appear under the heading of Tufted Grass, creeps by means of runners at the surface.

Sweet Vernal Grass has its underground branches very short. Yorkshire Fog creeps by runners above ground.

THE ROOT.

The roots of grasses are fibrous; in germination the roots which issue from the seed soon cease to elongate and die off; a number of new roots replace them, these new roots not branching from the first roots but taking their origin from the base of the stem (adventitious). In comparison with a deep tap-root system, say like Red Clover, grasses have a shallow root-system. There is, however, among individual species some variation in the depth of the root-system. This is represented, for example, among the cereals, where wheat goes deepest and barley has the shallowest root-system.

THE STEM.

The aerial stems of grasses are known as culms. The stem is round, and when grown, is hollow, except at the nodes (the stem of Indian corn remains solid). The nodes are the swollen regions on the stem from which the leaves spring. The

branches of a grass come from the axils of the lower leaves, from the nodes near the surface of the soil. These branches are known as "tillers." Tillering, then, is not the giving off of roots but the giving off of stems (branches).

THE FOLIAGE LEAVES.

The grass leaf has three distinguishable parts—the blade, the sheath, the ligule.

The blade is elongated and narrow, and typically has the veins parallel to one another. All the grasses named above

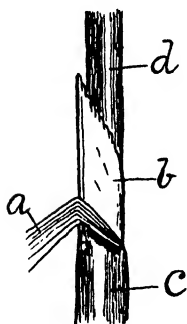


Fig. 25.—*Poa trivialis*.

a = Base of blade.
b = Ligule. c = Sheath.
d = Culm or stem.
Magnified. Copied from
Ward.

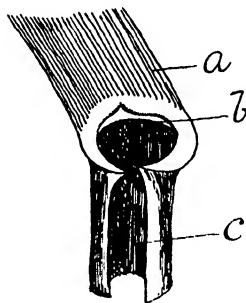


Fig. 26.—*Meadow Fescue*.

a = Base of blade.
b = The small ligule.
c = Sheath.
Magnified. Copied from
Ward.

have flat blades except *Aira flexuosa*, where the blade is a stiff bristle. *Aira flexuosa* is a weed grass of heaths and hills; its great risk is insufficiency of water, and this grass solves its problem by reducing its evaporating surface, surviving and indeed thriving as a bristle-bladed grass when as a flat-bladed one it would have gone under in the struggle for existence.

In attempts made to distinguish grasses by their leaf-blades attention is directed to the general shape of the blade, to its texture (soft or hard, dry or succulent, rough or smooth), to the nature of the apex of the blade and the margin of the blade, the veins, whether they are prominent and whether marked ridges are observable, and in young leaves how the blade is arranged before it has opened out.

A sometimes very useful character as an aid in telling one grass from another is the difference in arrangement of the leaves in the young unopened condition. There are two types of arrangement—the rolled or convolute, and the folded or conduplicate. By the rolled is meant that the leaf is rolled up like a scroll of music so that on being cut across we have a circular outline. By the folded condition is meant that the leaf is folded on itself from its middle, like a double sheet of note-paper, so that the two halves of the leaf are lying with what will be their upper surface face to face. A cut through this would give an oval. The rolled condition is the commoner

arrangement. The grasses treated here may be tabulated according to this character:—

FOLDED.	ROLLED.
Perennial Rye.	Italian Rye.
Cocksfoot.	Meadow Fescue.
Crested Dogtail.	Timothy.
Rough-stalked Meadow Grass.	Meadow Foxtail.
Smooth-stalked Meadow Grass.	Tall Oat.
Annual Meadow Grass.	Golden Oat.
	Sweet Vernal.
	Yorkshire Fog.
	Creeping Soft Grass.
	Couch.

In the folded condition of leaf the shoot is typically flattened or compressed. In the rolled condition of leaf the shoot is typically circular.

The sheath of the leaf. This part of the leaf envelops the stem. Typically, however, there is not a complete tube, for if one looks closely into the condition and pulls on the sheath, the sheath is observed to be a split sheath. Nearly all grasses have the sheath split. The only grasses among those dealt with here, which are exceptions, and have the sheath entire or unsplit are—

Cocksfoot.
Rough-stalked Meadow Grass.
Smooth-stalked Meadow Grass.

There are several grasses that can be distinguished by the colour of the sheaths of their lowest leaves. Thus—

Red.	Yellow.	Violet or Violet-brown.	White with red or purple veins.
Perennial Rye Italian Rye Meadow Fescue	Crested Dogtail	Meadow Foxtail	Yorkshire Fog Creeping Soft Grass

The Ligule. Just where the blade and the sheath meet there is a small scale called the ligule. This ligule varies considerably in length, shape, &c., and, as will appear later, is often made use of in distinguishing one grass from another.

THE INFLORESCENCE AND THE FLOWER.

The flowers of the grass are arranged in spikelets; the spikelets are generally numerous. The spikelets may be sessile

on the axis, in which case the inflorescence is said to be a spike; on the other hand, if the spikelets do not sit directly on the axis but have a stalk to them, the arrangement is known as a panicle.

Our grasses may be arranged as follows :—

SPIKED-EARED.

Perennial Rye.
Italian Rye.
Couch.
Crested Dogtail.
Timothy.
Meadow Foxtail.

PANICLE-EARED.

Meadow Fescue.
Cocksfoot.
Tall Oat.
Golden Oat.
Rough-stalked Meadow Grass.
Smooth-stalked Meadow Grass.
Annual Meadow Grass.
Sweet Vernal.
Yorkshire Fog.
Creeping Soft Grass.
Wavy Hair Grass.

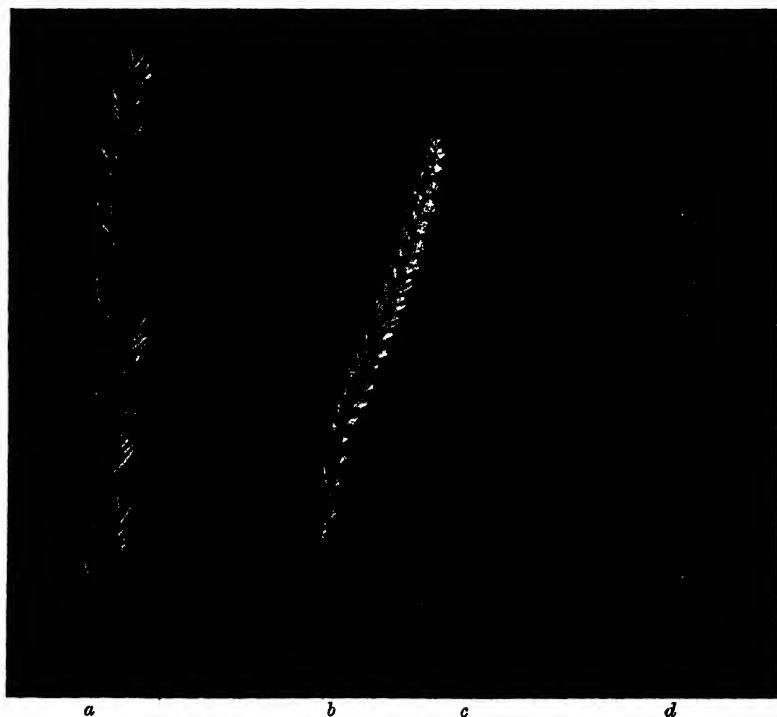


Fig. 27.

a = Ear of *Perennial Rye*.
c = Ear of *Timothy*.
(A young ear.)

b = Ear of *Crested Dogtail*.
d = Ear of *Meadow Foxtail*.
(The patch near the top is a bunch of stamens.)

All from nature and somewhat reduced.

Before the flower heads have opened out it is sometimes not very clear whether the inflorescence is spike or panicle, and some panicles have the stalks of the spikelets so short that they can be called spike-like panicles—*e.g.*, Sweet Vernal Grass. Crested Dogtail, Timothy, and Meadow Foxtail are, on minute examination, really spike-like panicles.

A SPIKELET AND ITS PARTS.

The inflorescence, or collection of flowers, is in grasses arranged in spikelets, and unfortunately the student of grasses trying by himself to worry out the parts of a spikelet by the aid of books finds himself confused over the number of terms, and over the fact that different books use different terms for the same thing. In describing here a spikelet and its component parts, I have given the various names that are used, and have chosen a large spikelet to illustrate the parts. The one chosen is Oat (Fig. 29), because the parts in the Oat spikelet are large enough to be made out by the unaided eye (far better, of course, with a good hand-lens); a beginner starting with, say, the small spikelets of Timothy, would find the dissection difficult. I strongly urge any reader who may not have worked at grasses, and who should happen to do so, to read carefully the description here given, because a knowledge of the terms used for descriptive purposes is absolutely necessary for the use of the keys, and for comparing one grass with another.

Figure 29 is an enlarged drawing of one spikelet of the Oat. A look at the figure shows that there is a number of leaf-like structures, that parts of a flower are visible, and that there are three seemingly similar bodies—a large one, a smaller one, and a very small one; that these three bodies are not floating in the air, but that each is attached to a stalk or axis that runs up the centre and is known as the axis of the spikelet. In nature and without dissection the parts of a spikelet are



Fig. 28.—Smooth stalked Meadow Grass.

Reduced. From Sutton's 'Permanent and Temporary Pastures'

so near one another that the details cannot be made out. Therefore in Fig. 30, a drawing made from Gordon's 'Manual



Fig. 29.—Spikelet of Oat showing three flowers, the innermost one rudimentary.

a = Glumes.

b = Outer pale of second flower.

c = Innermost rudimentary flower.

d = Stamens.

e = Awn from outer pale of lowest flower.

of British Grasses,' is shown a diagrammatic scheme of a spikelet with the parts so separated that the plan can be followed. The plan is that of a spikelet with three flowers in it. The thick, central, somewhat zigzag stalk is the axis of the spikelet. At its base are two leaf-like structures

on opposite sides of the axis of the spikelet, one a little larger than the other. These two leaves or leaf-scales are known as glumes (some books call them barren glumes). A little way up, and coming off on the right-hand side, is another small leaf or leaf-scale; this is known by a number of names—*e.g.*, outer palea or pale, lower palea or pale, anterior palea or pale, anterior bract, and flowering glume. No wonder the student gets confused. I will try in the descriptions which follow in this paper to refer always to this pale by the name outer pale. The reason for the terms outer or anterior is by way of contrast to another pale, whose back is nearer the axis of the spikelet. Very often this outer pale has projecting from it a bristle-like structure, called an awn (see Fig. 29). The awn is made use of in separating grasses from one another—thus, the presence or absence

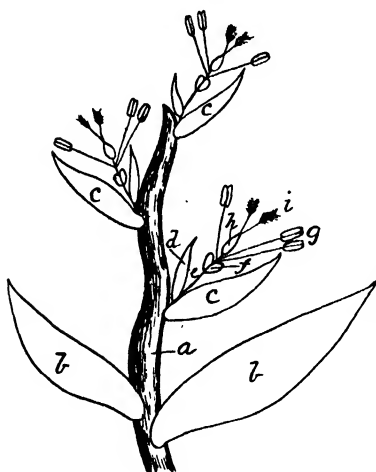


Fig. 30.

a = Axis of spikelet.

b = Glumes.

c = Outer pale.

d = Inner pale.

e = Flower stalk.

f = Lodicules.

g = Stamens.

h = Ovary.

i = Stigmas.

of the awn, the length of the awn, and where it arises on the pale—at the base, or middle, or apex, and so on.

Returning to Fig. 30, we observe that this outer pale has in its

axil a flower. Attached to the flower-stalk (in nature this is very short), and with its back to the axis of the spikelet, is another smaller scale-leaf known by the names, inner palea or pale, upper palea or pale, posterior palea or pale, posterior bract. I will try in the descriptions which follow to keep for it the name **inner pale**. The inner pale is a more delicate structure than the outer pale, and often has very characteristically a rib or keel at each side and no midrib.

Next, Figure 30 shows two small scales; these scales are known as lodicules; their true position is just inside the outer pale. The lodicules are very small, and a hand-lens must be used in order to make them clear; even with a lens there is in some grasses difficulty in making out the lodicules.

Next come three stamens, each with its stalk or filament, and its lobed head or anther.

Then in the very centre of the flower, shown at the top in the drawings we are examining, comes the pistil, formed by the folding on itself of a leaf or carpel, and consisting of an ovary or seed-box and two feathery stigmas.

In Fig. 30, but higher up and on the other side of the axis of the spikelet we again have an outer and inner pale, lodicules, stamens, and ovary with stigmas. Higher still, a similar arrangement of parts is seen.

The diagrammatic spikelet of the figure is a three-flowered one. The spikelet of Oat is also a three-flowered one (Fig. 29). At its base the two glumes are present, and they enclose the rest of the spikelet made up, in this case, of a lower flower, with the two pales enclosing it—the outer pale of this flower may have, as in Fig. 29, a well-marked awn,—a second flower and its pales, and a third, but small structure, which in most cases proves an abortive flower with only the two pales.

Fig. 31 represents a ground-plan of this three-flowered spikelet of Oat with its glumes. Generally in grasses there is one pair of glumes at the base of each spikelet. In Sweet Vernal Grass there are four glumes to the spikelet. The position and names of the parts should be carefully noted.

Fig. 32 represents the ground-plan of one Oat flower with its

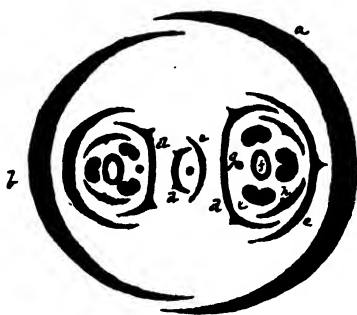


Fig. 31.—Ground-plan of three-flowered spikelet of Oat.

a and b = Glumes. d = Lodicules.
c = Outer pale. e = Stamens.
d = Inner pale. f = Ovary.

pales, and this figure can stand for the plan of the parts of almost any grass flower.

Fig. 33 shows the lodicules, ovary, and stigmas of an Oat flower.

Work of the Stamens.—Their business is to produce pollen for the pollination of the stigmas, and the fertilisation of the egg in the ovule of the grass ovary. After fertilisation the changes take place which result in the seed.

Work of the Ovary and Stigma.—The feathery stigmas catch and give attachment to the pollen grains. The ovary holds and protects the ovule, and later is the fruit with its one seed.



Fig. 32.—Ground-plan of grass flower.

a = Outer pale. d = Ovary.
b = Inner pale. e = Lodicules.
c = Stamens.



Fig. 33.—Lodicules and pistil of oat flower (magnified).

a = Lodicules.
b = Ovary (grain).
c = Stigmas.

Work of the Lodicules.—The flower of a grass, as we have seen, is enveloped in its two pales, and perhaps also by the glumes, and these must, for a time at any rate, be opened up to allow the stamens out to shed their pollen, and the stigmas to be exposed. In a ripe and ready grass flower the lodicules have swollen, and press apart the pales so that stamens and stigmas get out. After pollination the lodicules shrivel, the two pales come together again, and the ripening of the grain takes place under their cover.

NUMBER OF FLOWERS IN A SPIKELET.

In the illustrations given above, three flowers were shown in a spikelet. The number of flowers in a spikelet varies with the species of grass. In the grasses of this paper we have the following:—

- | | |
|------------------------------------|---|
| <i>One flower to a spikelet</i> | . Timothy. |
| | Meadow Foxtail. |
| | Sweet Vernal (with 4 glumes). |
| <i>Two flowers to the spikelet</i> | . Tall Oat (the lower flower male, upper flower perfect). |
| | Holcus (the lower flower perfect, the upper flower male). |

<i>Three flowers to a spikelet</i>	.	.	Golden Oat.
<i>Three to four flowers to a spikelet</i>	.	.	Rough-stalked Meadow Grass.
	.	.	Cocksfoot.
	.	.	Couch.
<i>Three to five flowers to a spikelet</i>	.	.	Smooth-stalked Meadow Grass.
<i>Four to six flowers to a spikelet</i>	.	.	Annual Meadow Grass.
<i>More than six flowers to a spikelet</i>	.	.	Perennial Rye.
	.	.	Italian Rye.
	.	.	Meadow Fescue.

Crested Dogtail is a special case. In it the spikelets are in clusters, several spikelets being attached to the same stalk; some of these spikelets are barren, but the fruitful ones have three to four flowers in them.

FRUIT AND SEED.

In strict botanical language a fruit consists of the ovary or seed-box with the seed enclosed. In the case of grasses the ovary holds one seed. During the development of this seed, growth takes place to such an extent that the outer part (coat) of the seed comes in contact with the comparatively thin wall of the ovary and the two become attached. The book-name for the wall of the ovary is the pericarp, so that a true grass fruit may be defined as pericarp with the true seed attached internally to it. Such a fruit is technically known as a caryopsis. Whenever in the course of this paper, and especially in the portion on identification of seeds, I have occasion to write of the caryopsis or one-seeded fruit of the grass, I will use the term grain. A grain of wheat consists only of the pericarp or seed-box wall and the seed. The usual thing, however, in grasses, is to have present in the so-called "seed" not only the grain but two pales; sometimes even the glumes are present. All through this paper I will use the word "seed" (seed in inverted commas), not in the strict botanical sense, but in its practical meaning as used by the farmer to indicate what he gets when he asks for grass seed, and what he sows. When a several-flowered spikelet is ripe and its "seed" ready, the axis of the spikelet generally breaks up into pieces, and as the "seed" falls away it carries, attached to it, its broken part of the axis of the spikelet. All through this paper in the description and identification of "seeds" the term rachilla is used to signify the broken part of the axis of the spikelet.

Fig. 34, which is the magnified "seed" of Bearded Wheat Grass, is an example of a "seed" that consists of rachilla, pales, and enclosed grain; an awn is also present. The rachilla in this grass is characteristic, being somewhat thicker above and hairy; it is next to the inner pale; only the rolled-in edges of the outer pale show in the figure,

and the awn which grows out from just below the apex of the outer pale. The grain cannot be seen; it is enclosed between the two pales.

Fig. 35 illustrates another type. It is the "seed" of Creeping Soft Grass, and consists of the whole spikelet, a two-flowered one; it really has 2 glumes, 4 pales, and a grain. The 2 glumes with short stiff hairs



Fig. 35.—"Seed" of *Holcus mollis*.

From nature.
Greatly magnified.



Fig. 34.—"Seed" of *Bearded Wheat Grass* *Agropyrum* (*Triticum*) *caninum*.

From nature. Greatly magnified.

a = Awn.
ip = Inner pale.
op = Outer pale.
r = Rachilla.

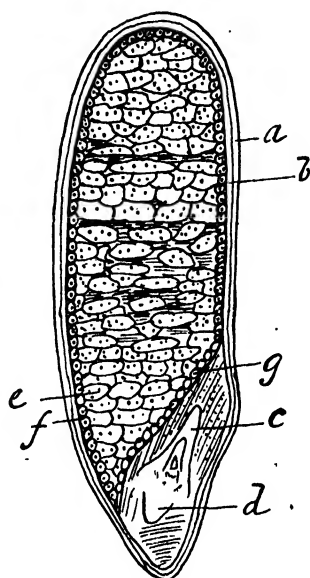


Fig. 36.—Longitudinal slice through the grain of *Italian Rye Grass*.

Magnified. After Wittmack.

a = Wall of ovary. *b* = Coat of seed.
c = Stem end of embryo.
d = Root end of embryo.
e = Cells containing reserve of starch.
f = Aleurone layer. *g* = Scutellum.

on their keels are prominent; nothing else can be seen but a portion of the outer pale of the upper flower and the bent awn that springs from it.

STRUCTURE OF A GRASS GRAIN.

If one examines a grain of wheat as it comes into the market, or dissects out, from between the pales, the grain of Rye Grass or any other, there will be seen at the base of one side the embryo grass plant; the embryo is seen through the thin pericarp. If such a grain be laid down and cut longitudinally, and the cut surface magnified as in Fig. 36, the general structure can be seen. At the outside is the pericarp or

wall of ovary; just inside this is the coat of the seed, next comes a layer of cells—the aleurone layer—containing nitrogenous reserve, and then the general mass of starch-containing cells. At the base the embryo is seen, with its plumule or stem end, its root end, and lying against the reserve the important part known as the scutellum. The scutellum secretes the ferment which, in germination, renders the reserve soluble and diffusible, and it absorbs the changed reserve.

THE GRASSES DESCRIBED AND COMPARED.

PERENNIAL or MEADOW RYE (*Lolium perenne*).

The first of the common names of this grass recalls the controversy—the ‘Transactions’ of past years have many references to it—as to whether *L. perenne* is a true perennial or not. In the controversy everybody seems to have been right, for the length of life of this grass is conditioned greatly by the nature of the soil and the circumstances in which it is grown. The culm is smooth. The leaf-sheath is flat and the blade folded so that a transverse section of a young shoot would be oval in appearance. If a tuft be pulled up and the lower leaf-sheaths examined they are seen to be red. The blade of the leaf is smooth on the under surface and has a keel; the base of the blade is eared. Ligule short. The inflorescence is a spike, the spikelets sitting in notches on the axis; the spikelets—like the leaves—are arranged in two rows (Fig. 27a), and are so fixed that the narrower margin is against or towards the axis. There is only one glume to each spikelet—instead of the usual two—the one to the outside of the spikelet (the topmost spikelet has two glumes). The glume reaches half-way up the spikelet. There are no awns.

The “seed,” as in the grasses that follow, is described later under the separate heading of Fruit and “Seed.”

ITALIAN RYE (*Lolium italicum*).

This grass resembles in general the preceding one, but easily recognisable differences in *italicum* are—

The leaves are rolled in the bud and the sheath is round.

The outer pales of the flowers have a well-marked awn.

DARNEL (*Lolium temulentum*).

This is the third *Lolium* species found in Britain. It can be distinguished from *L. perenne* by the presence of awns, and

from both *L. perenne* and *L. italicum* by the great length of the glume, which is as long or longer than the spikelet. Darnel is a weed grass, annual and not common.

MEADOW FESCUE (*Festuca pratensis*).

This excellent grass is a true perennial. The stems are smooth, but the portion that bears the ear is rough. The leaves are rolled in the bud, and so a cross slice of the shoot is round. The lower leaf-sheaths are red or purple red. The blade is flat. M'Alpine in his book on Grasses urges the use of a pocket-lens in examining leaf-blades, the blade being held up to the light with the upper surface to the observer. Examined in this way, M'Alpine shows how the blade of Meadow Fescue reveals a character which distinguishes it from *Lolium*, as the "veins appear as pure white lines" (in *Lolium*, examined by transmitted light, the veins are indistinct). Further, the margins at the base of the blade are rough. The base of the leaf is "eared." Fig. 26 shows two small ears, hook-like or sickle-like in form. The ligule is extremely small. The inflorescence is a panicle. The glumes are unequal in size—the lower one with a keel, the upper with three ribs. The outer pale is 5 ribbed and awnless; its lower part is rounded on the back, although the upper part may be keeled. Often the student, with only the flowering heads of the grasses to look at, is puzzled with Fescues and *Poa*. The difference in the outer pale will often prove helpful, thus—

FESTUCA.

The outer pale is rounded on the back, at least below.

POA.

The outer pale is strongly keeled on the back.

COCKSFOOT (*Dactylis glomerata*).

This is a perennial grass with a characteristic tufted growth. The leaves are folded in the bud, and a section across a shoot is oval-acute. The leaf-blade is large, with the apex acute; the blade has a keel, very distinct in the sheath, but there are no ridges. The sheath is unsplit, and downwards rough. The ligule, longer than broad, is large and conspicuous. The inflorescence is a panicle, with the spikelets crowded and thrown to one side. In the compressed spikelets the outer side is convex and the inner side is concave. Glumes keeled. The outer pale has five ribs. The keel or midrib is hairy, and at the apex is continued as a short awn.

CRESTED DOGSTAIL (*Cynosurus cristatus*).

This excellent pasture and good lawn grass is a perennial. The stems are erect, and after flowering become so hard and wiry that they are rejected by stock. This grass should therefore be well depastured. The rejected wiry culms make the presence of this grass easy to recognise, as they remain standing up through autumn and winter.

The leaves are flat and narrow; the ribs—on the blade being held up to the light—are very distinct on the upper surface but indistinct on the under; the apex of the blade is pointed. The leaf-sheath is split for only a short distance from the top. The basal leaf-sheaths are yellow. The ligule is very small.

The inflorescence is very characteristic. It is really a panicle, but looks like a spike; the spikelets are arranged on three sides of the axis; one side of the axis is thus left bare and can be traced by the eye right up to the apex of the flowering head (Fig. 27). The spikelets are not single spikelets, but are borne in clusters, and are of two kinds—barren spikelets made up of empty rigid scales, and perfect spikelets, each with several flowers.

TIMOTHY or CATTAIL (*Phleum pratense*).

This is a perennial grass; it flowers late. The stem is erect and smooth, and at its base is swollen to form a corm-like structure, and is therefore described as bulbous. The leaves are rolled in the bud. The leaf-blade is flat; held up to the light, ribs are evident though not projecting; if the edge of the blade be tested it is rough; leaf-sheath smooth. The ligule is thin, longer than broad, and toothed along the upper edge. The colour of the leaves is pale green.

The inflorescence looks very like a spike (Fig. 27), but the spikelets have short stalks to them. The inflorescence is long and rounded; it is rough when pulled through the fingers and lacks the projecting fine awns of Meadow Foxtail, although each of the two glumes ends in an erect stiff rough awn; these glumes are equal in size, truncate at the apex, and in each case have a keel which is covered with stiff hairs that run almost to the top. The spikelets are one-flowered, and the glumes quite enclose the pales and flower. The outer pale is awnless.

MEADOW FOXTAIL (*Alopecurus pratensis*).

This is a perennial grass, excellent both for meadow and pasture; a valuable grass on damp and stiff soils.

The aerial part of the stem is polished and marked with longitudinal lines. The leaves are rolled in the bud. The

blades are flat and are rough on both surfaces; the ribs on the upper surface, though not projecting, are quite well seen. The leaf-sheath is smooth. On pulling the grass up, the old leaf-sheaths are seen to be dark maroon or brown, and if these be removed and the younger sheaths exposed the colour is violet. The ligule is large and easily seen; it is blunt.

Meadow Foxtail is an early flowering grass. The inflorescence looks like a spike, but careful examination reveals that the spikelets—several to a branch—are carried on branches, therefore spike-like panicle is the truer definition. The ear is silver-grey in colour, and the apex is roundly blunt (Fig. 27).

The spikelets are flat and one-flowered. The glumes are joined at the base for about one-third of the way up, and have a distinct keel which is hairy; the side ribs are also hairy. The outer pale has an awn springing from its back, well down; the awn is straight to begin with, but is bent in the fruiting stage. The inner pale is absent. The ear is smooth to the touch.

TALL OAT (*Arrhenatherum avenaceum*).

This is a loose-tufted perennial, the underground branches being short. The aerial stems are smooth. The leaves are rolled in the bud. The expanded blades are thin and flat with a series of somewhat rough ribs; the colour is dark green. The sheath is keeled and smooth. The ligule is truncate and its outer surface is hairy.

The inflorescence is a loose panicle; expanded during flowering, but closer before and after flowering. The spikelets are two-flowered and the flowers are different, the lower one having stamens but no functional pistil, and therefore unable to produce seed; the upper one with both stamens and pistil. The two glumes differ in size. In the lower male flower the outer pale has a long, bent, twisted awn which arises from the back of the pale low down. The outer pale of the upper flower is typically awnless, but if an awn does appear it is small, and arises at the apex of the pale from between two small prongs.

THE BULBOUS VARIETY OF TALL OAT (*Arrhenatherum avenaceum*, var. *bulbosum*).

This variety can prove a pestilential weed as it multiplies vegetatively from stem-tubers. Some of the internodes at the base of the culm become places of storage. Reserve is passed into them, and the result is a chain of swollen tuber or corm-like structures, any one of which can, in suitable conditions, give rise to a new plant of the same kind. This variety is also known by the common names of knot-grass and pearl-grass.

GOLDEN or YELLOW OAT (*Avena* or *Trisetum flavescens*).

This perennial is also found in the form of loose tufts, because though there are creeping underground stems these remain short, and thus the aerial stems grow up somewhat near one another. The nodes may show hairs. The leaves are broad and thin with slender ribs; the colour is pale green. The leaf-sheath is hairy (examine the lower ones). The ligule is short but evident.

The inflorescence is a panicle with yellow spikelets whose axis is hairy. Typically each spikelet is three-flowered, and the flowers have both stamens and pistil. The glumes are keeled and rough. The outer pale ends in two short prongs, and from about the middle of its back arises a bent awn.

SWEET VERNAL (*Anthoxanthum odoratum*).

This is a perennial grass with short underground stems. The grass is an early one. The culms are erect and smooth. The leaves are rolled in the bud. The expanded blades are flat; the ribs that show on the upper surface have hairs on them. M'Alpine emphasises the "fringe of long hairs at the base of the blade." The blades are pointed at the apex. The leaf-sheath is hairy. The ligule is evident and thick and blunt.

The inflorescence is a panicle with one-flowered spikelets. A feature is the possession of four glumes at the base of the spikelets. The two lowest glumes are the longest, enclosing the rest of the spikelet; neither is awned. The next two glumes are hairy; each of them has an awn; one of the awns is short, springing from the back of the glume near the apex; the other awn is long and springs from the middle of the back. The outer and inner pales are awnless.

The flower has only two stamens, the only British grass without the typical three.

If the blade be chewed it gives a bitter taste from the presence of an aromatic principle—coumarin.

The odour given off from the dried plants in hay is well known, and in country places this grass is sometimes used—like lavender—in wardrobes and drawers holding clothing, partly for the odour and partly as a protection against insects.

THE GENUS POA.

In the grasses of this genus the inflorescence is a panicle and the spikelets are compressed or flattened; the glumes are shorter than the pales; the outer pale is keeled (not rounded) for its

whole length. The leaves are practically ridgeless, and close to the keel and parallel to it there are two longitudinal lines.

SMOOTH-STALKED MEADOW (*Poa pratensis*).

This perennial grass (Fig. 28) perennates by means of underground creeping stems. The aerial stems are smooth. The leaves are folded in the bud and the shoots flat. The blades are flat. There are veins, of course, in the leaf running parallel to one another in the longitudinal direction, but the tissue is not raised above and opposite the veins into ridges and so the blade is described as ribless. If the blade be held up to the light two longitudinal lines are seen running along the blade, one on each side of the middle line and close to it. These lines represent places where the tissue is thinner, and so they show when held to the light, as paler than the ground colour of the leaf. The blade is parallel-sided, with the apex rounded and somewhat concave or hooded. The leaf-sheath is flattened and unsplit. The ligule is short and not pointed.

The inflorescence is a panicle, pyramidal in shape when opened out; in the longer lower branches there is a considerable space before spikelets are given off. The spikelets are not harsh as in Fescues, but softer, and no awns are present. The glumes are about equal in size and keeled.

ROUGH-STALKED MEADOW (*Poa trivialis*).

This perennial grass has no underground creeping stems, but its runners are on the surface. The aerial stems are erect, but some of them before bending up into the air have grown along the surface of the ground for a short distance, rooting at the nodes. In contradistinction to the last grass, the stem of *P. trivialis* is rough, best proved if the finger be drawn upwards at the part of the stem below the ear. The leaves are folded in the bud. The expanded blades have the two lines, one on each side of the middle, characteristic of *Poa*; the blade tapers from base to apex, the apex being acute; under surface of leaf glossy. The leaf-sheaths are flattened and rough; they are unsplit unless torn. The ligule is conspicuous, longer than broad, and triangular—acute at the apex.

Inflorescence a panicle; in the lower branches, as in *P. pratensis*, there is some distance of stalk before the spikelets are given off. The outer pale is conspicuously 5-ribbed. The number of flowers to the spikelet is generally less than in *P. pratensis*—viz., three or two to three.

It may prove helpful to bring together in parallel columns the differences in vegetative parts between the last two grasses:—

Poa pratensis

Has creeping underground stems and branches.

Endures drought.

Culms smooth.

Blades broader, the edges parallel, the apex rounded.

Ligule short.

Poa trivialis

Has runners on the surface.

Thrives in moisture.

Culms rough on finger being drawn up the stem.

Blades narrower, tapering from the base, and ending in an acute point.

Ligule long and acute (examine the upper leaves).

ANNUAL MEADOW GRASS (*Poa annua*).

This is an annual grass of roadsides and waste places. It has compressed shoots. The leaf-sheath is flattened. The ligule is conspicuous. The leaves are thin and have the apex rounded; their colour is pale-green. No ribs are present on the leaves, but if one examine the upper surface of the leaf carefully (the under surface shows a slight keel) two lines are seen running down the blade near its middle. These lines are due to what have received the name of motor cells, and are present, as we have seen, in *P. pratensis* and *P. trivialis*. These rows of special cells have thin walls, and are water-holding cells. When they lose their water-content the blade (the cells are on each side of the middle line) is drawn together, its two halves folding. On the return of more favourable conditions as regards water these motor cells once more get charged with water, and the blades become flat again.

This mechanism of motor cells is one of the methods by which some grasses that live in sandy and exposed places protect themselves against over loss of water. When the sun shines and the conditions favour excessive evaporation, the motor cells yield up their water, and as a result the blade, which before was flat, becomes folded or rolled up like a scroll, exposing a less surface for evaporation, and so protecting its water content. Other grasses have their leaves permanently bristle-like, exposing only a small surface to evaporation—*e.g.*, Sheep's Fescue, which on exposed hillsides and subject to keen drying winds is, in such conditions, in danger of the outgo of water by evaporation being greater than the intake at the roots.

YORKSHIRE FOG (*Holcus lanatus*).

This is a perennial grass which forms tufts. The leaves are rolled in the bud. The leaves and the leaf-sheaths have soft woolly hair. If the basal leaf-sheaths be examined a diagnostic character is found in their colour—*viz.*, white, with red or purple veins. The ligule is short. The inflorescence is a panicle; close

and somewhat red in the young unopened stage, but when in full flower the panicle is open. Like the rest of the grass the panicle is hairy. The spikelets are two-flowered, the lower flower with stamens and pistil; the upper flower unisexual, having stamens only. The glumes are white in colour; they are flattened and their keels are hairy. The outer pale of the hermaphrodite flower has no awn; the outer pale of the upper male flower has an awn arising from its back; the awn is not at all prominent, as it is confined or hidden by the upper glume.

CREEPING SOFT GRASS (*Holcus mollis*).

This is a perennial with creeping underground stems or quickens. The aerial stems have a beard or tuft of hair at the nodes, whereas in Yorkshire Fog this is wanting, or there may be a little hair. The inflorescence is a panicle resembling that of *H. lanatus*. There are two flowers to the spikelet, the lower one hermaphrodite; the upper one male, just as in *lanatus*. From the outer pale of the male flower an awn comes, but in *mollis* the awn is longer and quite visible.

H. mollis does not appear so much in pastures or meadows, but is more a grass of waste places, hedge-sides, &c.¹

The differences between *H. lanatus* and *H. mollis* may be brought together:—

<i>H. lanatus</i> .	<i>H. mollis</i> .
Habit tufted.	Habit creeping.
The nodes of the culm without the hair tuft.	Nodes of culm with well-marked downwards-directed tuft of hair.
Rather a more woolly grass, the distribution of hair on leaves being more general.	The hair shorter and on the leaf-sheaths less abundant.
Glumes blunt.	Glumes pointed.
Awn hidden.	Awn clearly seen.

COUCH (*Agropyrum repens*).

A perennial grass with long creeping branched underground stems or rhizomes. The aerial stems are stiff, and if found at hedge or dyke-side they can be very tall. The leaves are rolled in the bud; the blades are thin and dry, and ash-green in colour.

M'Alpine emphasises as characteristic the two ears or claw-like appendages at the base of the blade and the characteristic ligule, which is very short, so small that it may seem absent, but magnified with a lens is seen to have a fringe of hair-like teeth. Hairs may be absent from the leaf-sheath but are present on the leaf-blade.

The inflorescence is a spike with the spikelets arranged in two opposite rows. The arrangement is sometimes confused with that of *Lolium*, but in Couch the spikelets are attached broadside-on—that is to say, the edges of the glumes are towards the spikelet-bearing axis. The glumes are 5 ribbed. The outer pales end in a stiff point sometimes lengthened out into an awn.

An *Agrostis* species confused with Couch is also a very troublesome weed grass. Confusion between *Agropyrum* and *Agrostis* can only take place because of the quickens or creeping underground stems. The flower heads are totally different, *Agropyrum* being a spike, whereas *Agrostis* has a panicle; another useful difference is that the ligule of *Agrostis* is quite distinct.

KEYS AS AIDS IN RUNNING DOWN THE GRASSES.

As aids in running down the grasses, just described in detail, two keys are offered by which perhaps the grass can be found before actual comparison with the fuller description. In the first Key the inflorescence is taken as furnishing the main divisions; the presence or absence of awns is also used. In this key Crested Dogtail, Timothy, and Meadow Foxtail are included under the Spiked Inflorescences, although if one carefully examine the flowering heads, the spikelets are seen not to be sessile but shortly stalked.

I. INFLORESCENCE A SPIKE.

1. Spikelets in two parallel rows, on opposite sides of the main axis—i.e., two sides of the axis bare.
 - A. Spikelets arranged with their narrower margin towards the axis.
 - a. No awn *Perennial Rye.*
 - b. Awn present *Italian Rye.*
 - B. Spikelets arranged broadside on *Couch.*
2. Spikelets arranged round three sides of the main axis; one side of the axis is bare of spikelets so that it can be traced right up the flowering head *Crested Dogtail.*
3. Ear cylindrical, with spikelets all round it.
 - A. Ear rough to the touch and bristly; awns not conspicuous *Timothy.*
 - B. Ear smooth and silky to the touch, awn quite conspicuous, glumes pointed *Meadow Foxtail.*

II. INFLORESCENCE A PANICLE.

1. Panicle spike-like; one flower to a spikelet with 4 glumes and 2 awns *Sweet Vernal.*
2. Panicle with the spikelets in clusters and thrown to one side; spikelets at the end of rough branches; awn, if present, a mere point *Cocksfoot.*

3. Panicle with spikelets not thrown to one side.

A. No awn.

a. Spikelets compressed ; outer pale keeled for its whole length.

x. Ligule short and blunt ; apex of leaf rounded
*Smooth-stalked Meadow.*y. Ligule (of upper leaves) long and pointed ;
apex of leaf acute *Rough-stalked Meadow.*

b. Outer pale rounded on its lower half

Meadow Fescue.

(While this grass has no awn there may be a minute prong at the apex of the outer pale. In Hard Fescue (Sheep's Fescue) there is a distinct awn.)

B. Awned.

a. Awn inconspicuous ; leaf-sheath white, with red veins.

x. Awn scarcely visible outside the spikelet ;
awn smooth ; no beard at the nodes*Yorkshire Fog.*y. Awn visibly projects from the spikelet ; awn
rough ; a beard of downwardly-directed
hairs at the nodes *Creeping Soft Grass.*

b. Awns conspicuous.

x. One awn (rarely 2) to a spikelet

*Tall Oat.*y. Three awns to a spikelet ; apex of outer pale
bifid . . . *Golden Oat.*KEY AS AID TO DISTINGUISH THE FOREGOING
GRASSES BY THEIR LEAVES.

In the Key that follows, the main divisions relate to whether the leaves are folded or rolled in the bud. The way to decide the matter is to make a transverse slice across the young leaves and shoot, and then to examine the cut by means of a pocket-lens.

Further, in the Key, ribs or ridges on the blade are often referred to. These should be looked for by the aid of a pocket-lens, the leaf-blade being held up to the light. It is an excellent plan to cut the blade right across and then examine.

I. LEAVES FOLDED IN THE BUD ; THE SHOOT IS FLATTENED.

1. Leaf-base eared (at the base of the leaf-blade there are two curling pointed projections) . . .
- Perennial Rye.*

The upper surface of the leaf of this grass shows distinct longitudinal ridges or ribs ; under surface shining and keeled ; ligule very small ; the leaf-sheaths of the basal leaves are red in colour.

2. Base of leaf not eared.

- A. Leaf-sheath of upper leaves split, or split only at the top; upper surface of leaf with distinct longitudinal ridges *Crested Dogtail.*

In this grass the basal leaf-sheaths are yellow, the leaves are firm, and the ligule is minute. (Crested Dogtail might appear under another main heading, as the leaves are sometimes slightly rolled.)

- B. Leaf-sheath unsplit; upper surface of leaf without distinct longitudinal ridges.

- a. The blade shows two longitudinal lines, one on each side of the midrib or keel; blades narrow.

- x. Ligule of highest-up leaves long and acute; blades pointed at apex *Rough-stalked Meadow.*

- y. Ligule short; blades rounded at apex *Smooth-stalked Meadow.*

- b. The blade without the two longitudinal lines; blades broad *Cocksfoot.*

The blades of this grass run out to a point, and they are rough on the surface and edge.

II. LEAVES ROLLED IN THE BUD; SHOOT ROUND.

1. Base of leaf-blade eared; the ears end in points.

- A. Basal leaf-sheaths red.

- a. Leaf-margin smooth; veins of leaf, on the blade being held up to the light, indistinct *Italian Rye.*

- b. Leaf-margin rough; veins of leaf show as distinct white or light lines *Meadow Fescue.*

- B. Leaf-sheaths not red *Couch.*

The leaves of this grass are thin and harsh, show scant hair, and the ligule is so inconspicuous that it seems to be absent.

2. Base of blade eared; the ears are rounded

Sweet Vernal.

The blades of this grass are thin, hairy at the edges, and have a beard of hair at the base of the blade; taste bitter.

3. Base of blade not eared.

- A. Leaf-sheath hairy (the hairs are long).

- a. Basal leaf-sheaths white, with red veins.

- x. Older leaves more hairy; margins not rough *Yorkshire Fog.*

- y. Older leaves less hairy; margins slightly rough *Creeping Soft Grass.*

- b. Leaf-sheaths without red veins

Golden or Yellow Oat.

The blade of Yellow Oat is hairy, the hairs showing along the top of the veins; the leaf-sheath is very hairy and not keeled; the ligule is hairy.

- B. Leaf-sheaths without evident hair, or scattered hairs may be present *Tall Oat.*

In this grass the edges of the blade are smooth, the sheath is keeled, the ligule is hairy on the back. (This grass should be compared with Timothy, lower down in the Key.)

C. Leaf-sheaths without evident hair.

a. Basal leaf-sheaths violet or violet-brown

Meadow Foxtail.

In this grass the ligule is broader than long, and hairy on the back.

b. Leaf-sheaths not violet or violet-brown, but light coloured *Timothy.*

In Timothy the edges of the leaf are rough (test the edge of the lower half with the tongue); the ligule is longer than broad, and not hairy on the back.

THE GRASS "SEEDS" AND HOW TO RECOGNISE THEM.

Before proceeding to describe and compare the "seeds" of the grasses and to offer a key or table by which they may be more easily found, it is necessary once again to remind the reader that the term "seed" as used generally in dealing with grasses is ambiguous. In the first place, no farmer when he asks for grass seed ever gets seed in the strict botanical use of the word seed. He may get various things according to the "seed" he asks for. Thus if he ask for a bushel of wheat seed he really will get a bushel of wheat fruits, for a so-called "seed" of wheat is really a fruit, or nut or seed-box containing in it one true seed. The seed-box—called ovary in strict botanical language—in grasses cannot be opened and its seed taken out, because the seed fills the box, and its outer-coat fuses with the inside wall of the seed-box. It will be remembered that such a fruit is known technically as a caryopsis. But the farmer in asking for grass seed may get more than a fruit. If he ask for barley seed he gets a one-seeded fruit surrounded by the two chaffy scale leaves known as paleæ or pales. If the "seed" asked for be Meadow Rye Grass, in addition to fruit and two pales there will be on one side at the base a small stalk. This small stalk is a portion of the stem or axis on which several flowers were borne, and when the fruits from these flowers were ripe the axis or stem bearing them broke up into pieces so that each single fruit that fell away carried with it its own minute part of the axis. This stalk or stem bearing the flowers, and later the fruits, is known as the axis of the spikelet or rachis, and we may call the minute part that is represented in the single fruits as the rachilla. Still, again, if the farmer ask for Meadow Foxtail seed he will get a seed-box with one seed in it—viz., a fruit, and also paleæ and glumes—that is, he gets the product of a complete one-flowered spikelet.

In the descriptions which follow I will use the term "seed" for what the farmer actually gets when he buys, and the term grain for the true botanical seed plus the seed-box or ovary. I also use the term outer pale to signify the lower or larger pale, and the term inner pale to signify the smaller upper pale which is next the rachilla. The student should make himself familiar with the terms (see the preceding pages where the spikelet and its parts are described) spikelet, glumes, outer or lower palea or bract, inner or upper palea or bract, axis of spikelet, rachilla, awn; he should also notice that the grain is sometimes grooved down one face and sometimes not. The length or size of the "seed" should also be noted as a help in distinction. I have always quoted this in millimetres; twenty-five millimetres make an inch.

In the examination of the "seeds" a hand-lens is necessary.

ITALIAN RYE GRASS (*Lolium italicum*).

The "seed" of this grass consists of two pales with a grain enclosed in them, and the rachilla. The outer pale has 5 ribs on it, and typically a long terminal awn; the back of the pale is curved or rounded. The length of the "seed" is 6 to 7 mm., and the awn by itself measures 6 mm. The rachilla is short and flattened, broadened out at the top and narrower at the base.

If the grain be dissected out from the pales it will be found to measure about $2\frac{1}{2}$ mm.; it is brown in colour and has a groove down one side.

MEADOW OR PERENNIAL RYE GRASS (*Lolium perenne*).

As in Italian Rye the "seed" consists of two pales with a grain enclosed in them, and the rachilla. The length is 6 to 7 mm. and typically there is no awn. The outer pale is smooth and somewhat rounded; it has 5 ribs best seen towards the apex (on occasion the central rib may be slightly prolonged as a short awn). The inner pale shows two rows of hairs. The rachilla lies up against the inner pale; it is flattened so that



Fig. 37.—*Italian Rye* (*Lolium italicum*).

Magnified. From nature.



Fig. 38.—*Perennial Rye Grass* (*Lolium perenne*).

Magnified. From nature.



Fig. 39.—*Festuca pratensis*.

Magnified. From nature.

a transverse section through it would be oval or somewhat triangular; this rachilla is broadest at the apex and narrows to the base.

MEADOW FESCUE (*Festuca pratensis*).

The "seed" consists of two pales with enclosed grain and the rachilla. The length is 6 mm.

The outer pale is rounded on the back, and the edges are membranous; it has 5 indistinct veins; there is no awn. The top end is thin and may be split. The rachilla is round, and the top is button-like, or flattened somewhat, as if one had hit the top with a hammer.

As sometimes Perennial Rye Grass "seeds" are present in labelled Meadow Fescue, the differences are given in two columns.

PERENNIAL RYE.

The top of the rachilla is the broadest part, and it narrows to the bottom.

Rachilla flatter and shorter.

Rachilla oval or triangular in section.

Rachilla lying close to the inner pale.

Middle nerve of outer pale less prominent.

"Seed" rather blunter.

MEADOW FESCUE.

The top of the rachilla is button-like or flanged.

Rachilla round and longer.

Rachilla round in section.

Rachilla not lying close to inner pale.

Middle nerve stronger.

COCKSFOOT (*Dactylis glomerata*).

The "seed" consists of the two pales with the grain inside. The length is 6 mm., including the awn at the apex, which by itself is 1 mm. long. The "seed" is somewhat triangular. The outer pale has a distinct keel, and the keel is bristly; there are well-marked ribs or nerves on the pale. Just below the apex of this pale there arises a stiff, prickle-like awn, which is curved. The rachilla is broadened out at the top into a distinct oval disc.

Colour, white-yellow or pale straw-coloured.

The grain, threshed out, is yellow or yellow-brown in colour, oval in shape, and measures 2 mm. long.

In commercial seed, specimens will be found that consist of two or more "seeds" attached to



Fig. 40.—*Cocksfoot* (*Dactylis glomerata*).

Magnified. From nature.

a broken-off part of the axis of the spikelet. The presence of these indicates a harvesting in unripe condition.

TIMOTHY or CATTAIL (*Phleum pratense*).

The "seed" of Timothy is generally the grain enclosed in the two pales. The pales are thin. It measures 2 mm. long and .75 mm. broad. Shape, rounded oval. Colour, whitish and silvery. Old "seed" lacks the silvery sheen, and is dim. The pales are thin; the outer one (on magnification) has 5 nerves or ribs (best seen towards the top), and the inner one has 2 ribs or keels.

In very ripe or threshed ears the grain (caryopsis) is freed from the pales. The naked grain is $1\frac{3}{4}$ mm. long, rounded, smooth, yellow-brown; it is not grooved.

If the whole spikelets be present the length is 5 to 6 mm., and in addition to grain and pales there are two glumes. The glumes are keeled; the keel in each case has bristly hairs and projects slightly at the apex.



Fig. 41.—*Timothy*
(*Phleum pratense*).

Magnified. From nature.

CRESTED DOGSTAIL (*Cynosurus cristatus*).

The "seed" consists of the two pales with the grain inside. The length is 4 mm., with slight variations. The outer pale is arched or rounded, and a keel is present, especially seen at the upper part; the apex is drawn out into a rough, bristly, slightly curved point; the lower part is smoother. Colour, light brown or brown red; the rounded broader part may be canary yellow and the upper part light brown. The inner pale is brown, sometimes canary yellow, and under the lens shows a number of dots. The rachilla is short and round; its tip is broadened out and disc-like.

The grain itself, removed from the pales, measures 2 mm. in length; it is flattened oval in shape, and a more or less distinct furrow can be seen.



Fig. 42.—*Crested Dogtail Grass*
(*Cynosurus cristatus*).

Magnified. From nature.

MEADOW FOXTAIL (*Alopecurus pratensis*).

The "seed" here is the complete spikelet. The spikelet is a one-flowered one, and in the ripe stage has the following

parts: two glumes enclosing the outer pale (the inner pale is absent in this grass) and the grain. The length is 5 mm. The



Fig. 43.—*Meadow Foxtail* (*Alopecurus pratensis*).

Magnified. From nature.



Fig. 44.—*Slender Foxtail* (*Alopecurus agrestis*).

Magnified. From nature.

two glumes are silver-grey or ash-grey in colour; they are keeled, and on keel and on side ribs there are long silky hairs that suggest eyelashes. The outer pale enclosed by the glumes has a long delicate awn arising from its back low down; this awn projects from the open apex of the spikelet and is bent and twisted.

The grain by itself measures 2 to 2½ mm.; it is yellowish in colour, oval and flattened; no groove is present. On the top of the grain there can often be seen a thread-like projection which is the remains of the stigma.

The "seed" of a wild species of *Alopecurus*—viz., *Slender Foxtail* (*Alopecurus agrestis*)—is sometimes present in true *Meadow Foxtail* as an adulterant. The two may be contrasted thus:—

MEADOW FOXTAIL.

Soft.

Flatter.

The hairs on the glumes silky and long and very noticeable. Owing to hairiness the "seeds" tend to hold to one another.

Broadest at the middle.

SLENDER FOXTAIL.

Hard.

The outer side arched, the inner somewhat hollowed.

The hairs not a feature of the seed, and hard and rough.

Broadest above the middle.

YORKSHIRE FOG (*Holcus lanatus*) and CREEPING SOFT GRASS (*Holcus mollis*).

The "seeds" of these two grasses appear as impurities among the "seeds" of useful grasses.

Yorkshire Fog.

The "seed" in the case of this grass is the complete spikelet. The spikelet in its ripe condition consists from below upwards of two glumes, a grain with two pales enclosing it, and two pales that hold nothing (this last is what remains of a unisexual male flower). The length is 4 to 5 mm. The glumes enclose the other parts; they are flattened, and have each a keel which

is hairy; their colour is white. The pales are grey-white. The two pales that enclose the grain are awnless. Of the two highest up pales the outer one has an awn; this awn arises just below the apex of the pale, and it is curved like a hook; it does not project, or only slightly.

The grain itself is yellowish in colour, oblong in shape, hairy at the apex, and grooved down one side.

Creeping Soft Grass.

This species comes very near the preceding one. The "seed" is here also the whole spikelet, and is made up of the same parts as that of Yorkshire Fog—viz., two glumes, two pales, and a grain, and two pales which, when the grass was in flower, held stamens only, and so could not produce a fruit or grain. The "seeds" of *Holcus lanatus* and *Holcus mollis* are best distinguished thus:—

Holcus lanatus.

Awn of the upper staminate (male) flower short.

Awn does not project and is not easy to see.

Awn curved like a hook.

Holcus mollis.

Awn of the upper staminate (male) flower long.

Awn projects and is easily seen.

Awn bent like a knee.

SWEET VERNAL GRASS (*Anthoxanthum odoratum*).

The spikelets of this grass are one-flowered spikelets, but instead of the usual two glumes there are four glumes arranged two and two: all four glumes are hairy. The "seed" consists of the two inner of these glumes, two pales, and a grain. Length, 3 to 4 mm., not including awns. The two glumes present in the "seed" are reddish-brown and hairy; each has an awn; the shorter awn is straight, the longer awn is bent or kneed; each awn springs from the back of the glume, about the middle. The long awn is sensitive to moisture, and its movement, according as it is absorbing or giving up moisture, causes the "seed" to actively change its position. The two pales are thin and smooth and enclosed in the glumes. The grain removed from glumes and pales measures $1\frac{1}{2}$ mm.; it is smooth, somewhat flattened, and is not grooved. The colour is light brown.



Fig. 45. — Sweet Vernal (*Anthoxanthum odoratum*).

Magnified. From nature.

A German swindle is Puel's Vernal Grass (*Anthoxanthum*



Fig. 46.—*Puel's Vernal Grass* (*Anthoxanthum pueli*).

Magnified. From nature.

pueli) (Fig. 46). This grass is a worthless annual; its "seed," consisting of the same parts as that of Sweet Vernal, may be distinguished by the colour. If seen in bulk the "seeds" of Puel's Vernal are lighter in colour.

TALL OAT (*Arrhenatherum avenaceum*).

The "seed" in this grass consists of the spikelet minus the two glumes. It consists of four pales and one grain. Two flowers are present in the spikelet—a lower and an upper. The lower flower is male or staminate, and its two pales persist into the "seeding" stage, but of course have no grain. The upper flower is a fertile one, and produces a grain which is covered by two pales.

The outer pale of the lower male flower has a very prominent bent awn; this awn springs from near the base of the pale, and measures 12 mm. in length; its lower half is a brown-and-white spiral, the upper half is thinner and all one colour. The pales are very distinctly ribbed. Of the two pales of the upper flower the outer one may or may not have a short straight awn. At the base of the "seed" is a marked scar, where the "seed" broke away, and a tuft of light hairs. The length of the "seed" is 8 to 9 mm.

If the grain be dissected out it will be found to measure 4 to 5 mm.; it is spindle-shaped and has no groove; its apex is hairy.

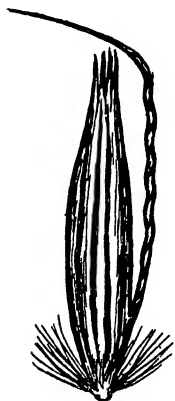


Fig. 47.—*Tall Oat Grass* (*Arrhenatherum avenaceum*) (*Avena elatior*).

Magnified. From nature.

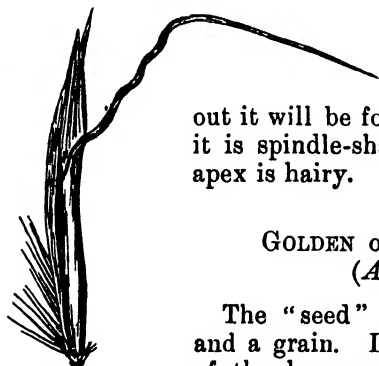


Fig. 48.—*Yellow Oat Grass* (*Avena flavescens*).

Magnified. From nature.

GOLDEN or YELLOW OAT GRASS (*Avena flavescens*).

The "seed" here consists of two pales and a grain. Length, 4 to 5 mm., exclusive of the long awn. Colour, whitish yellow or yellow. The outer pale is split at the top, the separated pieces being lengthened out as prongs. About the middle of the

back of this pale an awn arises; the awn is kneed and twisted. At the base of the pale is a fringe of hairs. The rachilla has well marked silky-white hairs. The grain measures $2\frac{1}{2}$ to 3 mm. in length; it is oblong oval and pointed at both ends.

An adulterant in Golden Oat Grass "seed" is the "seed" of the worthless Wavy Hair Grass (*Aira flexuosa*). The two can be thus distinguished:—

Avena flavescens.

Colour, whitish yellow.

Awn springs from about the middle of the back.

Rachilla with longer hairs.

Pales more delicate.

Aira flexuosa.

Colour darker, brown or red-brown or brown-yellow.

Awn springs from near the base of the outer pale.

Rachilla with shorter and fewer hairs.

Pales coarser.

It was the detection of substitution of worthless *Aira* for Golden Oat that really led to the establishment of Seed Control Stations. I heard the story in my student days many years ago when I was at the Forest School at Tharandt, near Dresden. I had gone there in order to study the Entomological Collection, and at the same time to make myself familiar with the well-known experiments which were being done by Professor Nobbe and Professor Hilltner in connection with the Bacteria of Leguminosæ. A Professor, when he was appointed Professor of Agricultural Botany at Tharandt, found in the museum of his predecessor a number of labelled glass jars containing samples of the "seeds" of grasses. Up to this time scarcely anybody had troubled to make serious and thorough studies of seeds for purposes of diagnosis. At one of the class meetings "seeds" from the jar labelled *Avena flavescens* were distributed, dissected, and drawn. A few days later the students were on a botanical excursion, and in the course of their observations came on a patch of *Avena flavescens*. The grass was examined, and then, for revision purposes, dissection was made of the flowering ears. On examination of the "seeds" it was seen that the "seed" previously examined in the classroom could not have been *Avena flavescens* in spite of this name on the jar. As a result, 1 lb. of *Avena flavescens* "seed" was ordered from six



Fig. 49.—Wavy Hair Grass (*Deschampsia (aira) flexuosa*).

Magnified. From nature.

of the leading seed warehouses in Germany. The various packages came, each labelled *Avena flavescens*. Only one sample was true to name, the other five held *Aira flexuosa*. There had been in this case no attempt to swindle; the habit had been to buy such seeds on the strength of the label and without guarantee. This incident led to a careful comparative study of grass and other seeds, and the result was the founding at Tharandt of the first seed control station.

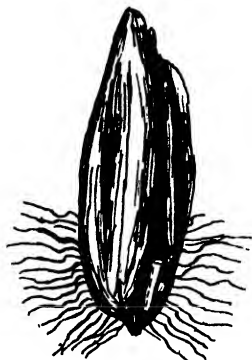


Fig. 50. — Smooth-stalked Meadow Grass (*Poa pratensis*).

Magnified. From nature.

SMOOTH-STALKED MEADOW GRASS (*Poa pratensis*).

The "seed" consists of two pales, a grain, and the rachilla. Length, 2 mm. and over. The back of the "seeds" is keeled so that they tend to lie on one side. There is no awn. The outer pale has five ribs, the midrib forming a distinct keel; the keel and the side ribs with silky hairs; at the base of the pale there is a tuft of long woolly hairs. Colour, brown or brown-white.

The grain itself is oval, pointed at both ends, and carries on its top remains of the stigmas; there is no groove, or a very indistinct one. The grain can be separated from the surrounding pales without difficulty.



Fig. 51. — Rough-stalked Meadow Grass (*Poa trivialis*).

Magnified. From nature.

ROUGH-STALKED MEADOW GRASS (*Poa trivialis*).

The "seed" consists of two pales, a grain, and the rachilla. Length, 2 mm. and over. The back of the "seed" is keeled so that the "seed" lies on one side. There is no awn. The outer pale has five ribs, more distinct than in Smooth-stalked Meadow Grass, but the hair on the keel and the side ribs is short; there are long woolly hairs at the base. The grain is not easily separable from the pales; at top and bottom the grain is rounded; a well-marked groove is present.

The tuft of woolly hairs at the base of the "seeds" of these two Poas is a prominent feature, and when the axis of the spikelet breaks up when the fruits are ripe the different pieces become entangled with one another on account of the webbing.

The "seeds" of these two grasses are often confused. I have known students who, instead of using eye and lens, preferred to make use of a bitten lead-pencil as a mechanical aid in determining the species, one of the two species becoming attached to the lead-pencil while the other species would not stick so easily. Stebler and M'Alpine bring together the various differences thus:—

Poa pratensis.

Outer or lower pale with long woolly hairs on the base and the back.

The outer or lower pale, seen from the side, is broad towards the apex, and its ribs scarcely project on the surface.

The upper or inner pale is slightly concave; its keels are covered by the margins of the lower pale.

The stalk of the topmost "seed" of each spikelet bears at its apex a globular appendage formed of rudimentary pales.

Poa trivialis.

Outer or lower pale with the web of woolly hairs confined to the base.

The outer or lower pale, seen from the side, is pointed towards the apex, and the ribs stand out on the surface.

The upper or inner pale has a deep longitudinal groove; the keels are bare and not overlapped by the margins of the lower pale.

The stalk of the topmost "seed" of each spikelet bears at its apex a long and acute appendage formed of rudimentary pales.

ANNUAL MEADOW GRASS (*Poa annua*).

The "seed" of this weed grass sometimes appears as an impurity; it consists of the same parts as the "seeds" of the two other Poas, and like these is keeled and lies on its side. It has the following characters which distinguish it:—

The "seed" is larger, 3 mm. and over; the side ribs on the pales are very distinct; the "seed" is somewhat woolly at the base, but there is no distinct webbing.



Fig. 52.—*Annual Meadow Grass* (*Poa annua*).

Magnified. From nature.

STRUCTURES COMPOSING THE "SEED" IN THE
VARIOUS GRASSES.

The so-called "seed" of the grasses, as we have seen, does not always consist of the same individual parts. In the chief grasses whose "seeds" have just been described the "seed" has represented in it the following parts:—

Grain (Caryopsis) alone.	Two Pales and a Grain.	Four Pales and a Grain.	Two Glumes, Two Pales, and a Grain.	Two Glumes, One Pale, and a Grain.	Two Glumes, Four Pales, and a Grain.
Timothy.	Timothy. Italian Rye. Perennial Rye. Meadow Fescue. Crested Dogtail. Golden Oat. Smooth- stalked Meadow. Rough- stalked Meadow. Annual Meadow.	Tall Oat.	Timothy. Sweet Vernal.	Meadow Foxtail.	Yorkshire Fog. Creeping Soft Grass.

Timothy "seed" may appear in three forms, but the commonest and most typical is where two pales and a grain compose the "seed."

In Tall Oat the four pales of two flowers are represented.

In Meadow Foxtail the "seed" is the one-flowered spikelet; only one pale is found in the spikelets of this grass.

In Yorkshire Fog and Creeping Soft Grass a two-flowered spikelet is represented, but only one flower produces a grain.

KEY.

In separating out the "seeds" their size is an important character, and whether awns are present or not.

The following Key is based in its main divisions on the characters just given:—

I. 2 MILLIMETRES OR LESS IN LENGTH.

(It is only when the whole spikelet is present that the size is greater.) *Timothy.*

II. No AWNS.

(1.) 2 to 3 mm. long.

A. Outer pale, with long woolly hair at base and also on back
Smooth-stalked Meadow.

B. Outer pale, with web of woolly hair at base
Rough-stalked Meadow.

(2.) 6 to 7 mm. long.

A. Rachilla flat *Perennial Rye.*

B. Rachilla round *Meadow Fescue.*

III. AWN IS A STIFF CURVED PRICKLE OR BRISTLY PRONG.

- (1.) The awn is a curved prickle ; "seed," triangular ; length of "seed," 5 mm. *Cocksfoot.*
 (2.) The awn is a curved bristly prong ; length of "seed," 4 mm. *Crested Dogtail.*

IV. A DISTINCT AWN (MORE THAN A POINT).

- (1.) One awn to the "seed."
 A. One flower represented.
 a. Two pales and a grain.
 x. Awn straight ; "seed," 6 mm. long. *Italian Rye.*
 y. Awn kneed or bent ; "seed," 4 to 5 mm. *Golden Oat.*
 b. Two glumes, one pale, and a grain ; "seed," 5 mm. long. *Meadow Foxtail.*
 B. Two flowers represented.
 a. Two glumes, four pales, and a grain.
 x. Awn not projecting ; "seed," 4 to 5 mm. *Yorkshire Fog.*
 y. Awn distinctly projecting ; "seed," 4 to 5 mm. *Creeping Soft Grass.*
 b. Four pales and a grain ; "seed," 8 to 9 mm. *Tall Oat.*
 (2.) Two awns to the "seed," the one straight, the other kneed ; "seed," 3 to 4 mm. long. *Sweet Vernal.*

LITERATURE ON GRASSES.

I have referred in the course of the paper to the following writings on Grasses. The books named would form an excellent library on Grasses.

Sowerby's English Botany. Vol. II. Gramina. This book has coloured figures of all the Grasses.

The Best Forage Plants. By Stebler and Schröter. Translated by Professor M'Alpine. This book has coloured figures of the chief agricultural Grasses.

The True Grasses. By Edward Hackel. Translated by Lamson-Scribner and Effie Southworth.

Grasses: a Handbook for Use in Field and Laboratory. By H. Marshall Ward.

Manual of British Grasses. By W. J. Gordon.

Agricultural Botany. By Professor Percival.

Grasses. By Professor M'Alpine. This book is unfortunately out of print, but those interested in Grasses should consult the article on Grasses by M'Alpine in Vol. 6 of 'The Standard Cyclopedia of Modern Agriculture.'

Permanent and Temporary Pastures. By Martin J. Sutton.

Of Floras, much detail is given in Bentham and Hooker's 'British Flora,' and in Hooker's 'Students' Flora of the British Islands.'

BRACKEN (*PTERIS AQUILINA*): LIFE-HISTORY AND ERADICATION.

By G. P. GORDON, B.Sc. (Edin.), B.Sc. (Oxon.), West of Scotland
Agricultural College, Glasgow.

In the present paper an endeavour is made to deal with the economic bearing of bracken to the industries of Agriculture and Forestry. A preliminary note on a portion of the experimental work was submitted at the meeting of the Highland and Agricultural Society of Scotland in July 1914.

In the year 1902 the Highland and Agricultural Society appointed a Committee to inquire into the extent of the spread of bracken, and to devise if possible some useful method of eradication. The finding of this Committee is contained in the 'Transactions' of the Society, vol. xv., 1903, p. 449.

Since the year 1905 Lieut.-Col. Fergusson-Buchanan has carried out experiments on the cutting of bracken at Auchentorlie, Bowling, and these, along with similar experiments carried out by Mr S. Millar, Tighnabruaich, are referred to in the 'Journal of the Board of Agriculture and Fisheries,' October 1911. Further reference to the Bowling experiments is made in the 'Scottish Farmer,' October 11, 1913, and in the 'Scottish Land Report,' 1914. In addition, the Board of Agriculture and Fisheries received a communication from Sir Ronald Munro Ferguson of Raith, Kirkcaldy, on this subject, a note of which is contained in the Journal for January 1914.

With a view to correlating the experimental work already done, and possibly extending it, investigations were commenced at Auchentorlie, Bowling, by the West of Scotland Agricultural College in the summer of 1913, and these are being continued.

As a preliminary measure, in order to obtain definite information regarding the prevalence and evil effects of the bracken pest in certain districts, schedules containing lists of questions were circulated by the College throughout the bracken-infested districts in its area. As a result of the inquiry, a large amount of valuable information was obtained.¹

The experimental plots (each $\frac{1}{4}$ acre in extent) which were

¹ This inquiry and the experiments conducted at Auchentorlie having served their purposes, Principal Paterson has now commenced a systematic investigation with a view to following up and adding to the experimental work already done. The investigation is at present being carried on in the counties of Argyll, Dumfries, Dumbarton, and Lanark, and will in all probability be commenced in other counties during the present year.

over 1500 feet, and it is probable that it may be found at still higher elevations.

As regards soil conditions, bracken has a preference for deep free working soils which are fairly fertile. It would appear to be rather intolerant of very moist or acid conditions in the soil, and is not usually found in association with peat¹ (Fig. 54x²).

On areas where bracken is dominant, dense pure groups occur (Fig. 55x), but mixed associations with heather or grass are also of frequent occurrence, and in these the plant is not

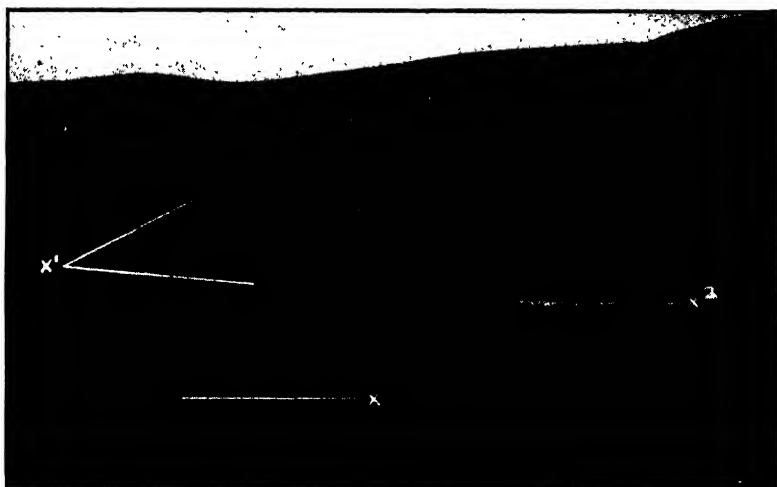


Fig. 54.—General distribution of bracken.

Showing (x) occurrence on pockets of deep soil; (x¹) occurrence of heather and hill grasses on ridges; (x²) absence of bracken on peaty areas.

so abundant. In woodlands it forms a natural association with oak, birch, alder, and rowan, and is here a half-shade plant.

A point worthy of notice is that bracken (*Pteris aquilina*) and bilberry (*Vaccinium Myrtillus*), either of which is tolerant of fairly deep shade, may be dominant both under shade conditions and also in the open. The development in height growth of bracken grown in the shade is invariably greater than that grown in the open.

In association with heather, bracken always tends to become dominant and suppress the heather, especially if the association is somewhat open.

¹ See E. P. Farrow, "On the Ecology of the Vegetation of Breckland," 'Journal of Ecology,' iv., 1915, p. 224.

Extent and Method of Spread.

The encroachment of bracken on hill grazings and on planting areas within recent times has had the effect of seriously menacing the economic utilisation of such lands, consequently they have depreciated greatly in value. The actual rate of increase varies according to locality, but cases are recorded in which within a period of twenty years an area under bracken has doubled itself. From a single centre it has been observed to spread radially a distance of from three to five feet annually.



Fig. 55.—*Group formation of bracken.*

Showing (x) centres of bracken groups.

The reason for this rapid increase within recent years is somewhat difficult to explain, and probably several factors have been at work in bringing it about. As is well known, the head of cattle carried by hill farms has been much reduced of late, and the bracken, especially in the young stages, has consequently escaped the trampling action of cattle. Heavy stocking such as existed on crofter grazings undoubtedly limited the spread of bracken; in fact, there seems to be some truth in the saying, "The bracken is the heir to the crofter." Further, injudicious heather-burning—*i.e.*, allowing heather to get too old before burning—has in many cases been responsible for the spreading of this fern. If old heather having a thin crop of

bracken through it be burned, the bracken invariably becomes dominant, and ultimately suppresses the heather.

At one time bracken was much in demand for thatching purposes. When put to this use it was always pulled by hand, and this method is probably the most effective, though not the most economic, means of eradication.

Finally, the absence of prolonged winter frosts within the last cycle of years has assisted the underground buds (Fig. 56x) in standing the winter.

The combined effect of these various factors has resulted in the predominance of bracken in the majority of infested localities.

Life-history.

Bracken (*Pteris aquilina*), like the other members of the group of vascular cryptogams, shows in its development an "alternation of generations." The bracken plant represents the asexual generation. It consists of a horizontal underground portion (Fig. 56) (the rhizome or true stem of the plant), and a



Fig. 56.—*Bracken rhizome.*

Showing (x) underground bud ; (x¹) bracken roots ; (x²) young bracken shooting curl.

vertical stalk-like portion (the leaf-stalk or petiole) which bears towards its apex the frond with its small divisions or pinnæ. The rhizomes ramify horizontally in the soil at a depth of from six to twelve inches, and may attain a length of some three or four yards. In places where bracken is abundant the rhizomes form a dense mesh-like layer in the soil. The rhizomes bear buds (Fig. 56x) in addition to roots, which are represented by rather delicate hair-like processes (Fig. 56x¹).

The spore-producing parts of the plant are the pinnæ or leaves (Fig. 57). These bear on their under surfaces clusters or sori of sporangia (Fig. 58x), which are partially protected by the

incurving edge of the pinnæ forming a "false indusium" (Fig. 57x). The outer wall of the sporangium is a well-defined layer (Fig. 59x) within which the bracken spores (Fig. 59x¹) are contained.

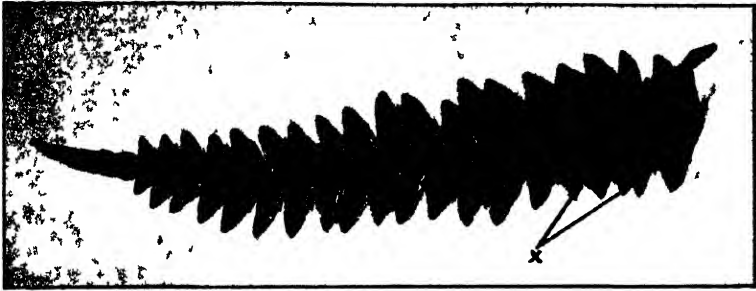


Fig 57 — *Spore bearing part of bracken plant*

Showing (x), false indusium formed by incurved edge of pinna

On germination these spores give rise to a sexual generation. The plants consist of small green prothalli somewhat similar in appearance to liverworts. On the prothallus arise the sexual organs, the antheridia (male) and the archegonia (female).

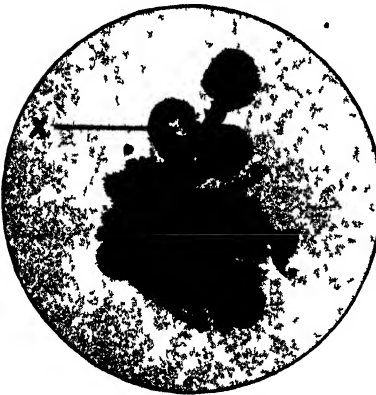


Fig 58 — *Sorus of bracken sporangia*

Showing (x) individual sporangium
magnification 40 diameters

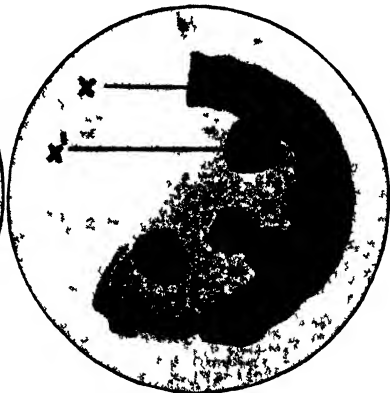


Fig. 59 — *Ruptured bracken sporangium*

Showing (x) outer wall of sporangium (x¹) bracken
spore magnification 190 diameters

After fertilisation the egg-cell develops into a multicellular embryo, which becomes the bracken plant or asexual type, and thus completes the life cycle.

The group formation of bracken (Fig. 55), in addition to experimental evidence, goes far towards proving that bracken

spreads mainly by rhizomes which give rise to underground buds, and these in turn produce new bracken plants. Although myriads of spores (Fig. 59x¹) are produced on each bracken plant, no specimen of a prothallus was recorded in the course of the experiments. In nature conditions would seem to be generally unfavourable to the germination of spores, since bracken is invariably found on dry, well-drained soils. In addition, the humus formed where bracken is dense keeps the surface loose and dry, and on sparsely stocked bracken land the sole of grass produces a similarly dry surface. These dry conditions would seem to make it difficult for spores to germinate and for the prothalli to develop.

A further proof is obtained in the fact that although bracken ground is burned over either in spring or autumn, the growth and spread of the bracken is in no way checked, and hence we are forced to the conclusion that the plant spreads mainly by means of underground buds.

This conclusion is supported by evidence from other sources. Mr E. P. Farrow¹ states that "as the bracken does not spread across narrow ditches, reproduction by spores apparently does not typically occur here, but cases have been observed in which bracken is commencing to grow in rabbit burrows a long way from a main bracken association. Here it has in all probability spread by spores; the bottom of the rabbit burrows were apparently damp enough for the production of prothalli, although the surface of the grass-heath is far too dry for them."

Nature of Damage.

Bracken damages hill grazings in a variety of ways. In the first place it reduces the food supply by suppressing the natural grasses and heather, which necessitates a reduction in the stock kept. Secondly, it renders the supervision of a hill farm more arduous and less efficient—*e.g.*, sheep with heavy fleeces get "cast" in the bracken and are often not found until too late. Similarly sheep affected with maggots or ticks make for bracken patches and escape the notice of the shepherd. Further, the combing action of bracken-stalks on the fleece causes the wool to become matted, which, along with the inevitable incorporation of pieces of bracken, renders clipping much more difficult.

There is also a widespread belief that the occurrence of "sickness" in certain districts bears some relation to the prevalence of bracken in these localities. It has been observed that soft etiolated grass comes up under the protection of the

¹ "On the Ecology of the Vegetation of Breckland," 'Journal of Ecology,' iv., 1915, p. 224; photos 7 and 8.

withered bracken in the early spring, and it is held that when this material is frosted and eaten by sheep stock it causes "sickness" in some cases.

In the case of planting ground the occurrence of bracken, especially in dense patches, is particularly harmful. It acts in the first place by suppressing young plants and checking normal growth. Further, when bracken is "laid" by snow or heavy rain in winter the plants are also dragged down and injured. Dense bracken renders it almost impossible to suppress rabbits, as in summer it obscures the burrows, and the rabbits when persecuted leave their burrows and breed in the bracken.

Methods of Eradication.

That the complete eradication of bracken can be accomplished by persistent cutting has been established by the previous Auchentorlie experiments. The methods of eradication adopted up to the present have been: (1) topping the bracken in the early stages of growth by means of sticks or chain-harrows; (2) cutting the bracken either with machines, scythes, or hooks at later stages of growth. The method of topping which is very often employed on planting ground consists of breaking the bracken shoot when in the curl (Fig. 56x²). This has been found to be an efficient though somewhat costly method.

Experience so far has shown that on average bracken land the most economic method of eradication is cutting by means of scythe or hook. It is only under special circumstances that a machine can be used to cut bracken over extensive areas.

The Bowling experiments were designed with a view to arriving at some definite conclusions regarding the best periods at which to cut, and how often to cut each year. Accordingly, a very uniformly stocked piece of bracken land was selected, about ten acres in extent, in the spring of 1914. Plots 1 to 6 were set out (Diagram 1) in this area, each being $\frac{1}{10}$ acre in size. Plots 1 and 2 were raked clear of dead bracken and sown down with a grass seeds mixture after being fenced off with rabbit netting. Plot 3 was cut once, on July 7th; Plot 4 twice, on June 7th and July 7th; and Plot 5 three times, on June 7th, July 7th, and August 7th; while Plot 6 was cut whenever bracken made its appearance. Along the edge of the plots a strip of the original bracken was left as a control. At the end of the growing season Plots 1 and 2 carried a dense crop of tall bracken, while Plot 6, which was cut continuously, was practically bare of bracken. On Plot 3 the crop was on the whole thin, and had an average height of some 32 inches,

Plot 4 had produced a dense crop of bracken, with an average height of 35 inches, while Plot 5 contained a thin crop of bracken averaging 16 inches high. The bracken on the control plot was very dense and had attained an average height of 6 feet 3 inches. It is observed that Plot 3 was cut once only—viz., in July—Plot 4, which was cut twice—viz., in June and July—carried a denser and slightly taller crop than Plot 3, so that the June cutting had no effect. The later August cutting in Plot 5 is seen to have had a very decided effect.

These results indicate that it is more effective to cut bracken at certain definite times rather than indiscriminately, and that it should be cut just before it reaches maximum height growth, late cuttings being more effective than too early ones. The reason for this is probably the fact that by a later cutting a larger amount of tissue, and therefore of food storage, is destroyed. If the proportion of bracken foliage be taken as an indication of the amount of food stored in the rhizomes, two cuttings, one about the beginning of July and one in August, are probably most effective. The principle underlying the practice of cutting involves a draining action on the food stored in the rhizome, the effect of which is seen in Fig. 63. The results of investigations conducted in America show that the best times of cutting in southern New York are about the middle of June and the middle of August.¹

During the following year no cutting operations were conducted on the plots, and it was observed at the end of the growing season that, with the exception of Plot 6, there was practically no difference between any of the plots and the control area. It would appear, then, that treatment for one year has little or no effect. Plot 6 had produced a thin crop of short bracken.

The cost of cutting, especially twice each year for several years in succession, and the scarcity of labour at the time when cutting is most effective, have in the past made it almost impossible to deal with large areas.

Throughout these experiments it was recognised that the labour involved in cutting largely influenced the economic value of this method of eradication. Consideration was therefore given to methods in which, for a similar expenditure on labour, a much larger area could be treated than by cutting. In addition, it was recognised that anything more effective would naturally diminish the time during which treatment was necessary, and therefore reduce the cost of the operation.

Accordingly, about the end of June, Plots 7 to 12 inclusive were laid off, each $\frac{1}{20}$ acre in extent, and these were sprayed

¹ H. R. Cox, "United States Department of Agriculture," *Farmers' Bulletin*, No. 607, September 1915.

with various liquids. The complete experimental scheme was as follows:—

Plot No.	Size.	Treatment.	No. of times sprayed.
1.	$\frac{1}{20}$ acre	Raked and sown with grass seeds mixture	...
2.	"	do.	...
3.	"	Cut once, on July 7th	...
4.	"	Cut twice, on June 7th and July 7th	...
5.	"	Cut three times, on June 7th, July 7th, and August 7th	...
6.	"	Cut continuously whenever bracken appeared	...
7.	"	Sprayed with 15 per cent sol. ferrous sulphate	Once
8.	"	Sprayed with 10 per cent sol. ferrous sulphate	Once
9.	"	Sprayed with 8 per cent sol. copper sulphate	Once
10.	"	Sprayed with 4 per cent sol. copper sulphate	Once
11a.	$\frac{1}{20}$ acre	Sprayed with 5 per cent sol. sulphuric acid	Twice
11b.	"	Sprayed with $2\frac{1}{2}$ per cent sol. sulphuric acid	Twice
12a.	"	Sprayed with 6 per cent sol. hydrochloric acid	Once
12b.	"	Sprayed with 3 per cent sol. hydrochloric acid	Once
13.	$\frac{1}{20}$ acre	Dusted with powdered ferrous sulphate $\frac{2}{3}$ cwt.	...
14.	"	Dusted with powdered "kainit," 1 cwt.	...

The spraying was done by means of a knapsack sprayer carried on the shoulders. In the case of all the plots, except Plot 11 (a and b), the application of the spray had no appreciable immediate effect other than the browning of a few of the leaf tips, nor was there any marked after-effect.

Plot 11 (a and b), however, which was sprayed with sulphuric acid, responded almost immediately to the treatment. In the course of a few hours the bracken fronds wilted and became light-brown in colour. About the third day the stems became black and withered, as a result of the acid being conducted from the surface of the pinnæ along the midrib and down the stalk. This action is an important one, since the acid thus gains access to a portion of the plant which is never affected by

cutting—viz., that portion below ground. After a week the plot contained only plants of the type illustrated in Fig. 60. Several of these plants were dug out, and the acid was found to have penetrated almost to the rhizome. Finally, the bracken assumed the winter condition and went down completely.

About four weeks after the first spraying a fresh crop of bracken had appeared, and the plot was again sprayed. The effect of the second spraying was even more striking than the first, and the bracken "went down" completely for the year.

The (a) section of the plot was sprayed with a 5 per cent solution, while on the (b) section a 2½ per cent solution was used. Although the effect was very decided in both cases, it was more rapid and marked on section (a).

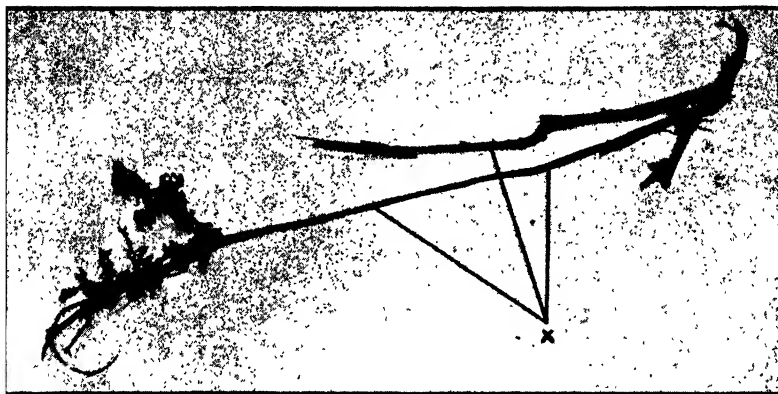


Fig. 60.—Action of sulphuric acid spray on bracken plant.

Showing (x) action of acid on leaf-stalk.

One might expect that the pasture grasses, if any existed below the bracken canopy, would also be affected by the spray. The experiments demonstrated, however, that even a fairly thin canopy of bracken was sufficient to protect the grasses, and thus the pasture was not affected. The effect of this treatment was well demonstrated throughout the winter, as the sole of grass was much thicker than ever before. In the spring of the following year the bracken on this plot was slower in coming than that on the other plots, including the control plot; in addition, the grass came earlier and was better than the surrounding pasture.

Fig. 61 shows the condition of Plot 11 exactly one year after the first spraying. When this is contrasted with Fig. 62, which represents the same plot before spraying, some idea of the efficacy of the method is obtained. The operations were con-

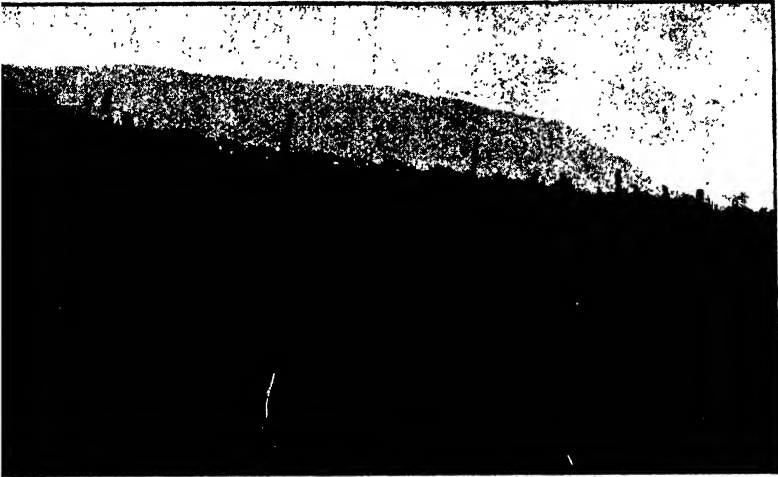


Fig. 61. — *Present condition of Plot 11 sprayed with sulphuric acid in 1914.*

ducted on rough hill land, and the method can be applied wherever a man can walk. Further, it entails infinitely less



Fig. 62. — *Condition of Plot 11 before spraying in 1914.*

labour than cutting, and has the distinct advantage that larger areas can be treated by this method in less time than by any other means yet suggested.

The best times to spray with sulphuric acid appear to be early in July, at the stage when the fronds have almost, though not quite, completely unfolded, for in this condition the epidermal layer is still delicate and therefore easily penetrated. A second spraying might be conducted early in August, after the second crop of bracken has come up. The spraying operations in the second year would be altogether determined by the density of the bracken on the treated areas. In this connection it should be noted that in the event of the bracken being weakened to such an extent by one year's spraying that only a thin crop appears in the second year, it would be advisable to cut the stragglers rather than spray the whole area, as in such a case the spray would probably have a deleterious effect upon the pasture grasses.

The method adopted in making up the spray was as follows: the sprayer, having a content of some $2\frac{1}{2}$ gallons, was almost filled with water (which can be taken from any stream or spring), and about $1\frac{1}{2}$ lb. sulphuric acid (S.G. 1.72) was added, making a 5 per cent solution. The sprayer was manipulated as in spraying charlock with the nozzle set, so as to direct the spray slightly above the horizontal plane. In this way a breadth of three yards could be taken on each side of the sprayer. The actual cost per acre of eradication by this method must vary according to the local conditions. Generally speaking, however, it may be said that the cost per acre was about one-third of the cost of cutting. The respective costs per acre were based on the total expenditure, including labour necessary in each method—viz., cutting and spraying to completely destroy the bracken for one year.

Plots 13 and 14 were treated with powdered ferrous sulphate and kainit respectively. In order to make the solid adhere to the bracken leaves the plots were sprayed first of all with water, and the powdered substances then applied from a sowing sheet. Plot 13 received a dressing at the rate of $\frac{2}{3}$ cwt. per acre, but no appreciable effect was produced on the bracken.

The dressing on Plot 14 was at the rate of about 1 cwt. per acre, and this was observed to have a decided effect on the bracken. By the second day after application the tips of the fronds had crumpled up and turned black, the tops of the stalks were also affected, and the whole plot assumed a brown appearance. The action, however, proceeded no further, so that the bracken did not "go down." The effect was similar in nature to that produced by sulphuric acid, although very much less intense, and the method could not be considered as a means of eradication, since the following year Plot 14 produced as strong a crop of bracken as formerly.

CONCLUSION.

In the course of the investigations a large body of evidence was obtained demonstrating the fact that the encroachment of bracken on hill pastures in Scotland has now given rise to a very serious economic problem. In times like the present, when every effort is being made to increase the food-producing capacity of the country, the bracken problem should receive due consideration. The speed with which bracken is known

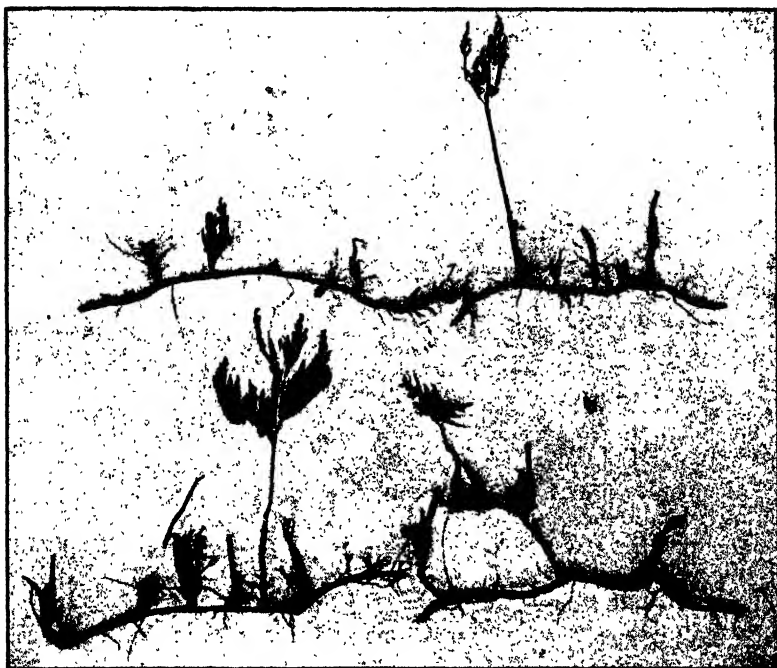


Fig. 63.—*Draining effect produced on bracken rhizome by methods of eradication.*

to spread from a centre points to the fact that it will rapidly become the dominant plant in many localities. Numerous instances were recorded in the investigation of the general distribution of bracken which went to prove this. As to the manner in which bracken spreads, observation and experiment go to prove that it is mainly by propagation from the rhizomes.

As far as the experimental work carried out justifies any definite conclusions, the most effective means of eradication appears to be one which, by acting on the vegetative part of the plant above ground, produces the maximum draining effect on the underground rhizome (Fig. 63). The intensity of this

draining action is influenced by the season of the year, and also by the frequency of the operation.

Just as in cutting bracken, operations should be conducted at definite times (viz., in July, and again in August, the exact time depending on whether the season is early or late), so in spraying bracken there is a particular period in which the operations will produce a maximum effect. In a normal season this period occurs some time early in July, and again early in August.

As regards the relative intensity of the draining actions produced by cutting and spraying respectively, there is no doubt that, under the conditions governing this particular set of experiments, the effects of spraying are much more intense than those due to cutting operations.

A somewhat significant fact was also demonstrated by the experiments—viz., that in spite of the large variety of sprays employed only one was really effective. Certain of the sprays used have very destructive effects on other plants though not on the bracken. This goes to prove that the vegetative parts of the bracken plant are extraordinarily resistant, as compared with the corresponding parts of many other plants.

The results of the experiments demonstrate that the cost of cutting is approximately three times the cost of spraying. Further, in spraying, a much larger area can be more effectively treated so as to produce a more lasting effect. In view of the experimental evidence, it would seem fair to draw the conclusion that the method of eradication by spraying with sulphuric acid is essentially practicable, and can be applied to any kind of hill land, with results which are in accordance with the greatest economy and efficiency.

In conclusion, I desire to express my great indebtedness to Lieut.-Colonel Fergusson-Buchanan, who, in addition to assisting materially in the organisation of the experiments, set at the disposal of the College a large area of bracken land, and also supplied the labour necessary for the conduct of the experiments.

INSECT AND ARACHNID PESTS OF 1915.

By R. STEWART MACDOUGALL, M.A., D.Sc., F.R.S.E., Consulting
Entomologist to the Society.

LICE.

SUCKING Lice or Anoplura are small wingless insects with the head narrower than the thorax; the feet end in a single claw, and are adapted for clasping and clinging. The metamorphosis is incomplete. The eggs or nits are glued to hairs, or in the case of the body louse of man, to clothing. The young from the eggs resemble in general (there may be differences in the number of antennal joints) the parent, save in size; they attain the adult condition after feeding and moulting. All are parasitic, living externally on Mammals, on whose blood they nourish themselves. Plagues of lice have been known since early periods, and some of the old notions as to the origin of lice are very quaint. Thus in the fifteenth century Bartholomew wrote: "A louse is a worm of the skin, and grieveth more in the skin with the feet and with creeping than he doth with biting, and is gendered of right corrupt air and vapours that sweat out between the skin and the flesh by pores. And some lice gender of sanguine humour and be red and great; and some of phlegmatic humours and they be nesh and white; and some of choleric humours and be citrine (yellow), long, swift, and sharp; some of melancholic humour and they be coloured as ashes and be lean and slow in moving. And the leaner that a louse is the sharper she biteth and grieveth."

Of the three Pediculine lice which may infest man, *Pediculus humanus (vestimentum)*, the Body Louse has been oftenest sent to me. This, of course, is due to the special circumstances of the moment. This louse calls for special mention, not only because of the irritation it causes but also from its being the carrier of the dreaded typhus.

The Clothes or Body Louse (*Pediculus humanus*) measures from 3.19 mm. to 4.13 mm. in length. It has an elongated abdomen, and its six legs are all equally strong; the margins of the abdomen are only slightly lobed; the end of the abdomen of the male is rounded, that of the female cleft. The louse holds on by a thumb-like prolongation of the lower leg and the claw that ends the foot, these two being opposable or able to be brought together like a pair of forceps. The mouth apparatus

is fitted for sucking. Schiödte, a Danish entomologist, as quoted by Cummings in the 'British Museum Pamphlet,'¹ thus describes an experiment with a louse which he allowed to fix itself on the back of his hand: "Scarcely does the abominable little monster feel the heat of the skin before it lays aside its former disheartened attitude and begins to feel at ease; its antennæ oscillate for joy, and it stretches all six legs complacently out from the body. But though the pleasure and surprise at the sudden transportation into congenial surroundings for the first moment eclipse everything else, hunger soon asserts its claim, sharpened as it is by the long fast which has rendered the stomach and intestines quite transparent. The animal raises itself on its legs, walks on a few steps, seeking and feeling its way with its antennæ, while we follow it with a magnifier. Presently it stops, draws in its legs a little, arches its back, bends its head down towards the skin at an oblique angle, while it probes a small narrow organ repeatedly forwards, and draws it back through the fore end of the head; at last it stands still, with the point of the head firmly abutted against the skin;" its mouth parts are then buried and it begins to suck.

In Warburton's experiments, quoted in his Report to the Local Government Board, new series, No. 2, 1909, the eggs were found to hatch in periods varying from 8 days to 5 weeks; the larval stage lasted for 11 days. Under the most favourable conditions the length of a life cycle from egg to egg would be about 24 days. A male lived three weeks and a female four weeks. The female lays a large number of eggs; in Warburton's experiment one female laid 124 eggs. The louse has only a short life apart from its host. The continuous wearing of clothing gives the temperature necessary for the hatching of the eggs, and so favours the increase of the infestation.

The Clothes Louse and Typhus.

The Clothes Louse, an ashaming creature if present in ordinary conditions of life, has abundant opportunity to flourish where men are crowded together without proper opportunities for bathing and for change of clothing. Such conditions are specially present in camps and in war campaigns, where it must often happen that the soldier has no chance to change his dress for days or perhaps for weeks at a time, and has to wash where and when he can. Thus such lice, as in the present war, have in many wars proved a source of great irritation to soldiers. This irritation is severe enough, but the matter becomes of enormous importance when we remember that armies have been deci-

¹ The Louse and its Relation to Disease. By B. F. Cummings (British Museum, Natural History).

mated by typhus, and that the typhus carrier and transmitter is this Clothes Louse. It is because of campaigning conditions, which lead to the multiplication of lice, that war and typhus are so closely associated.

Nicolle, in Tunis in 1909, transmitted typhus from one chimpanzee to another by the sucking of an infected Clothes Louse. Since then United States workers have confirmed the results. On our Western Front probably the danger of typhus is not great, not because lice are not present, but because, as typhus is not endemic in the West, the virus is not present, and so the lice themselves are not infected. There are cases in Western European countries, but the cases are not numerous. The risk is greater in Eastern Europe, in parts of which typhus is endemic, and owing to insanitary conditions (in Balkan countries for example) the risk is always great. The conditions in which typhus—a dreaded and easily conveyed disease—flourishes are lack of food, general destitution and weariness, overcrowding, and non-change of clothing with the presence of lice. The greatest preventive is cleanliness. Up till now no vaccine or serum has been found which, without doubt, enables the patient to ward off the disease.¹ The destruction of lice and their eggs and the disinfection of clothing are the best preventive measures, and great efforts have been made to accomplish these, and to ensure bathing as far as possible.

There are insecticides of proved value against lice. Two very effective and very safe remedies and preventives now in use by medical officers are Naphthalene-Iodoform-Creosote, known shortly as N.C.I., and Vermijelli.

The formula for N.C.I. powder is—

Naphthalene	.	.	.	.	.	96 parts.
Creosote	.	.	.	.	.	2 „
Iodoform	.	.	.	.	.	2 „

This powder is dusted specially on underclothing once a week.

Vermijelli is made by Messrs Bowley & Son, Wellington Works, Battersea, and sold in tins. It is a crude oil emulsion made from Lefroy's formula. Protection is afforded against lice by smearing the skin with it, or applying it in socks or inside boots and puttees, and along the seams of clothing.

Paraffin oil and benzine kill lice readily, but in camp and crowded conditions their use is dangerous from the risk of fire.

A successful method of exterminating vermin is given in a Memorandum by S. Monckton Copeman, M.D., F.R.C.P., F.R.S.,

¹ Experiments to find a serum against typhus have been in progress for some time, and as this passes through the printer's hands, the discovery of a serum is announced from the Pasteur Institute.

in the 'Lancet' and the 'British Medical Journal' for 6th February 1915. The Memorandum reads: "Arrangements should be made for the bathing of affected individuals and other inmates of infected tents. After drying themselves, men to lather their bodies with cresol soap solution (water, 10 gallons; Jeyes' fluid, $1\frac{1}{2}$ ounces; soft soap, $1\frac{1}{2}$ lb.), especially over hairy parts, *and to allow the lather to dry on.* Shirts to be washed in cresol soap solution made with boiling water. Tunics and trousers to be turned inside out and rubbed with same lather, especially along the seams. *Lather to be allowed to dry on the garment.*"

Infected blankets were at first treated by soaking them in cresol soap solution, after which they were sent to a neighbouring laundry to be washed. In the first week in November, however, a portable Thresh's steam disinfecting apparatus was supplied to the Division, since when no difficulty has been experienced in the disinfection both of clothing and blankets.

The 'British Medical Journal' for 2nd October 1915, and the 'Pharmaceutical Journal and Pharmacist' for 23rd October 1915, quoted from a German Medical paper (Deut. Med. Woch.) the statement that "German investigators have come to the conclusion that sulphur vapour is the simplest and cheapest as well as the most effective agent for the destruction of lice and their eggs in clothing and buildings. There have been many victims to typhus in the German Army, and elaborate measures have been adopted with a view to stamping out the disease, such as the conversion of sugar factories into disinfecting stations where the soldiers and their clothing are treated, and in prisoners' camps experiments have been carried out with a view to ascertaining the cheapest and most effective way of destroying lice. One of the features of the plan consisted in thoroughly washing all cracks and corners in the building with a 3 per cent solution of cresol soap and then filling them up. The clothing was hung up loosely in the huge room, the floor of which measured 450 square metres, and 25 kilos of sulphur was burned in sixteen sulphur stoves. The burning proceeded rapidly and reached its maximum in forty-five minutes. In three hours doors and windows were thrown open, and two hours later the building was occupied by the men who meanwhile had been washed. Complete destruction of the lice and their eggs was found to have taken place. The sulphur vapour has been shown to kill lice and their eggs in two hours."

Regarding sulphur, Mr William Beaverly Cowie, Ph.C., F.C.S., wrote to me on 24th November: "During the months of June, July, and August I experimented with a number of vermin exterminators which could be employed by the soldiers on

active service, and after employing all the ordinary exterminators I had no difficulty in coming to the conclusion that sulphur dioxide acted quickly. I found that a small quantity was all that was necessary, provided that the gas was allowed to pass through the garments freely—i.e., the garments laid out for treatment had to be well loosened out. Under these conditions sulphur dioxide never failed. Besides, vermin carefully avoid garments treated with this gas.

"I have found the sulphite of any of the alkaline earths quite suitable for giving off sulphur dioxide, as they seem to decompose slowly at body temperature, and they have the great advantage of being non-poisonous. Free sulphur was tried again and again under varying conditions, but it had no effect on the vermin whatever."

THE SUCKING LOUSE OF THE HORSE (*Hæmatopinus asini* (*macrocephalus*)).

This insect has come to me for determination a number of times from home training camps, and from the front. The *Hæmatopines* are very near relations of the *Pediculidæ*; they have a longer piercing and sucking proboscis, and their eyes as compared with *Pediculidæ* are inconspicuous or absent.

Hæmatopinus asini is common in Britain, and the same causes that result in other lice appearing in great numbers apply here—viz., want of attention and reasonable cleanliness. Thorough cleanliness and proper grooming are the best preventives of this enemy of the horse, and in the present circumstances this is difficult. Even in peace time there is room for a more thorough grooming. *Hæmatopinus asini* found on horse and ass measures $2\frac{1}{2}$ to $3\frac{1}{2}$ mm. in length. The head is elongated and narrow and is longer than the thorax, and its sides are almost parallel; all six legs are of equal size and strength, and have a triangular pretarsal sclerite visible under the microscope; thorax brown in colour and the abdomen grey-yellow.

This louse is found in the long hair of the leg and the dorsal aspect of the body, especially about the shoulders, flanks, and root of mane and tail. As regards its life-history, the female glues her somewhat pear-shaped or rounded eggs towards the base of a hair; from the free broad end of the egg hatches a young form which externally resembles the parent, and assumes the adult condition after feeding and moulting.

The horse *Hæmatopine* when present in numbers causes a harsh dry coat, considerable loss of hair, and excoriation of skin. Sometimes it is present in great numbers in the lower part of the limbs—chiefly in the heavy type of horse in which

the coarse hair provides shelter—especially the hind limbs, and in consequence there is much stamping, and difficulty in shoeing owing to the itchiness. There is also loss of condition and spirit from the continual irritation and insufficient rest.

Treatment.—Clipping is always advisable. One of my colleagues has found the following successful:—

Arsenious acid	1 oz.
Soft soap	2 oz.
Carbonate of soda	1½ oz.
Water	2 pints.

Dissolve by boiling, dilute to 5 gallons with water, and apply after clipping body and limbs. In thin-skinned horses this sometimes causes slight irritation of skin, but never anything of moment. It is cheap as well as efficient. There should be two dressings, with an interval between them of seven to ten days. *If this dressing be chosen, there should be caution against the use of drinking buckets for holding the preparation.*

Another cheap and effectual dressing is a 2 per cent solution of creolin. Stronger solutions are unnecessary and irritant.

Perchloride of mercury, 1 to 1000 of water, is sometimes used for the legs of horses. It is effective at little cost, but it should not be employed over the whole of the body.

Eggs or nits are often in great numbers on the hairs, and the majority can be got rid of by thorough grooming; the young lice, from the eggs that escape and hatch, will be caught by the second dressing.

THE BITING LOUSE OF THE HORSE (*Trichodectes parumpilosus* (equi)).

The Biting Lice or Mallophaga are small wingless insects which do not pierce the skin and suck blood, but nourish themselves on pieces of hair, epidermal scales, and in the case of birds on pieces of feather bitten off by their mandibles. If present in numbers on the host, they are the cause of irritation as they move over the host with their clawed feet. Away from a host they do not survive more than a few days. There is a large number of species which affect birds chiefly, hence the common name of Bird Lice applied to the Mallophaga. Only one genus affects domesticated mammals—viz., the genus *Trichodectes*.

Trichodectes parumpilosus of the horse seems to be much rarer than the Sucking Louse of the horse (*Hæmatopinus*), but recently a large number of *Trichodectes parumpilosus* were sent to me, taken from a charger not long landed from America.

The female measures $1\frac{1}{2}$ mm. and the male a shade less. The head is square and carries two small three-jointed antennæ. The part of the thorax that is immediately behind the head is slightly narrower than the head. The six legs are chestnut-coloured and are strong; each ends in a single claw. The conical abdomen is yellowish, with the edges darker. The female glues her eggs singly to the hair of the horse. From the egg hatches a minute creature smaller and paler than the adult, but otherwise in form and food habits resembling the parent. The adult stage is attained after a feeding and a series of moults, and without any resting stage. The treatment is the same as for the Sucking Louse.

MANGE OF THE HORSE.

The horse may suffer from three kinds of mange—Sarcoptic, Psoroptic, and Chorioptic (Symbiotic)—all belonging to the family Sarcoptidæ. Of these three kinds of mange, or scab, or itch, the Sarcoptic is the most troublesome to treat. Far the commonest kind of mange is the Psoroptic, which at a time like this can be the cause of immense trouble and loss. Cases of mixed infection have come under my notice in the past autumn and winter, and several cases where death resulted.

Sarcoptic Mange.

Sarcoptic mange is due to the mite *Sarcoptes scabiei*, var. *equi*. This mite has a rounded body, greyish in colour, sometimes with a tinge of red. On the shoulders, on magnification with the microscope, very short cone-like projections are visible; on the back, minute scales with their points backwardly directed, and small thorns on each side of the rump. The male measures about $\frac{1}{10}$ th of an inch in length, and the female may measure up to $\frac{1}{8}$ th of an inch. Of the four pairs of legs in the male, one, two, and four have their last joint carrying a stalk terminated by a sucker; each of the third pair of legs ends in a long hair, no stalk and sucker being present. In the female the front two pairs of legs have the stalk and sucker; the two hind pairs of legs end in a long hair.

Life-history.—The female *Sarcoptes equi* mines in the skin of the horse. It passes readily to the ass and mule, and is also transmissible to man; on man, however, the consequent disease is not so severe, and yields readily to treatment. The female lays her eggs in a gallery or mine in the skin, which she has dug out by means of her mouth parts. She moves always for-

wards, as the scales and spines on her body prevent a backward movement. In her wake in the gallery dark excrement can be seen, and eggs in different stages of development. At the front end of the gallery the female herself can be found on careful search.

From the egg there hatches a larva that resembles in general form the adult, but only six legs are present. The two front pairs of these legs are terminated by stalk and sucker; each of the third pair of legs ends in a hair or bristle, stalk and sucker being absent. This larva pierces its way to the outside through the roof of the mother gallery, and after several moults passes into the nymph stage.

The nymph has four pairs of legs, the two front pairs with stalk and sucker, the two hind pairs ending in a hair or bristle. The nymph develops sexual organs, and we now have ripe males and females. Pairing takes place on the surface of the skin. The fertilised female grows, and after a last moult acquires a special egg-laying organ. The egg-laying female burrows into the skin and a new cycle is started.

Parts attacked, and Symptoms.

The Sarcopt of the horse generally begins about the withers or shoulders, and spreads to the sides of the neck and to places in contact with the saddle and girth. In the spread of the disease long-haired parts are avoided. Noël-Pillers' experience, however, with this parasite leads him to the view that the parts most affected are the "sub-maxillary space, the tracheal region, the brisket, the belly," all thin-skinned places. The symptoms are a restlessness and an itching, worst when the skin is overheated or warm. The horse bites itself and rubs itself against convenient bodies; it shows pleasure when groomed, leaning towards the brush or currycomb, turns the head to one side, and makes a characteristic movement with the lips. This movement with the lips is an extremely useful diagnostic feature in early stages of mange—not only Sarcotic, but also Psoraptic—when otherwise there is a risk of failure in diagnosis. Later, before there is any loss of hair, small pimples can be felt as the hand is passed over the skin. The pimples consist of crust round the bases of a few hairs. When these crusts are removed with the fingers small moist spots are left. The pimples are at first scattered; they burst with the rubbing, and the secretion from them dries into a crust. As the disease spreads different patches run together and a large crust may be formed. The hair drops out and the skin wrinkles and thickens. Cracks show in the skin, and the bases of the

cracks and folds are moist with serous or purulent exudate. A sour fetid odour is given off. Rubbing and friction causes bleeding.

In neglected cases the general health is affected; there is disturbance of the functions of the skin; the itching prevents rest, and nutrition is interfered with; there is loss of condition, and after some months, in untreated cases, death may follow.

PSOROPTIC MANGE OF THE HORSE (*Psoroptes communis*,
var. *equi*).

This mange affects the horse, ass, and mule, but does not pass to other domesticated animals. The scab-mite, which is the cause of this mange, measures $\frac{1}{16}$ th inch long in the male, and the female up to $\frac{1}{8}$ th inch.

The male has four pairs of legs. The first three pairs of these carry, projecting from their last joint, a three-jointed stalk terminated by a sucker; the two hindmost legs are short and have no stalk and sucker; the third pair of legs is the longest. If magnified under the microscope there can be seen at the hind end of the abdomen two lobes, and also two copulatory suckers.

The female has the first, second, and fourth pair showing the three-jointed stalk and sucker; the third pair of legs lack the stalk and sucker but end in two long hairs. No abdominal lobes or copulatory suckers are present.

Further, in external form, *Psoroptes* differs from *Sarcoptes* in the body, being more oval, and the rostrum more elongated. In addition, all the eight legs are easily visible, whereas in *Sarcoptes* the two hind pairs of legs are inconspicuous when the mite is viewed from above.

The Psoropt of the horse may be found on almost any part of the body—but the common places for infestation are parts protected by hair, at root of tail, inner side of legs, at edge of mane, withers, and back. This scab-mite does not mine into the skin like the female *Sarcoptes*, but still the pests give rise to intense itching owing to the constant pricking of the skin by their mouth parts. As a result of the irritating punctures papules appear; these break and a fluid exudes; this fluid dries and crusts are formed. Under the crusts and at the edges of them the mites live and propagate. The stages in the life-history—adult, larva, nymph—are as in *Sarcoptes*. The treatment for this mange is the same as that for *Sarcoptic* mange, but the cure is more rapid and easier where there is thorough attention.

Treatment for Mange in Horses.

Too much emphasis cannot be laid on the importance of thoroughness in treatment. Where mange has made progress cure is stubborn, especially in Sarcptic mange. In order that the dressings may the better reach the mites clipping should take place. Then there should follow a washing with soap and water, a lather being formed. After washing down with water the body should be scraped dry with a straw wisp (the straw wisp should be burned immediately after use). The animal is now ready for the dressing which will kill the parasites. There are various recommended dressings—*e.g.*, mercurial preparations, tobacco preparations, kerosene-emulsion preparations, but none are so generally satisfactory as sulphur, potassium carbonate, and an oil. One such dressing is—

Sulphur	.	.	.	.	1 ounce.
Oil of terebinth	.	.	.	.	1 ounce.
Spirits of tar	.	.	.	.	1 ounce.
Liquor of potass	.	.	.	.	1 ounce.
Rape oil	.	.	.	.	1 pint.

Another highly recommended dressing is—

Sulphur	.	.	.	.	1 part.
Potassium carbonate	.	.	.	.	$\frac{1}{2}$ part.
Sperm oil	.	.	.	.	4 parts.

The sulphur and the potassium carbonate should be thoroughly mixed together and the oil stirred in gradually.

This is applied thoroughly to the animal after the clipping and washing.

For a week or a few days more the horse should be looked at now and again, so that any affected parts that have been rubbed bare may be redressed.

Then should follow a thorough washing down with soap and water in order to remove all of the previous dressing.

A second course of treatment should follow on the same lines, and then a third—*i.e.*, the animal would be three times treated in three weeks to a month.

Very great care must be taken against spread of the disease. No treatment can be considered satisfactory which neglects the great risks of infection. The disease can spread very easily from horse to horse, therefore infested horses should be isolated. When the horses are clipped small pieces of crust fall away with the hair, and both hair and crust probably harbour the mites, therefore there should follow a sweeping together and burning. Before sweeping, it is a good plan to disinfect by

spraying with paraffin emulsion or a 4 per cent solution of carbolic acid. Stalls, litter, harness, and articles used about the animal should be carefully disinfected. A painter's flare may be used in this work. Brushes, currycombs, and clippers should be dipped in paraffin emulsion after they have been used; harness should be scrubbed in a 3 per cent solution of creolin.

At the close of the treatment one should not feel absolutely certain of complete success, and the animal should be kept under observation for a month.

CHORIOPTIC OR SYMBIOTIC MANGE OF THE HORSE.

This mange is due to the scab-mite *Chorioptes (Symbiotes) equi*. This scab-mite has come under my observation several times during the year. The male measures up to $\frac{1}{7}$ th inch in length and the female to $\frac{1}{8}$ th inch.

In the male all four pairs of legs end in stalk and sucker, but the stalk is so short that the sucker appears to be sessile; the sucker is large. The hindmost or fourth pair of legs are much thinner than the other legs. Abdominal lobes and copulatory suckers are present.

In the female the first, second, and fourth pairs of legs end in stalk sucker; the legs of the third pair end in two hairs. There are no abdominal lobes and no copulatory suckers.

In both sexes all eight legs are easily visible from above, and the rostrum is as wide as long.

This mange is often known as pastern mange or leg mange. It is usually confined to the limbs, and only in very bad cases is it high up on these. This mange spreads very slowly in a stable as compared with the other manges. Changes in the skin and hair do not become very pronounced until the disease has been in progress for a considerable time. A symptom of attack in the early condition is the repeated stamping of the hind legs. There is besides stamping, biting, scratching, and rubbing. Stamping and kicking are dangerous in the handling of the hair or leg for examination, and the risks make clipping not only dangerous but impossible. The itchiness and stamping are always more marked at night in stables.

The hair, harsh and dry, comes out in patches, and a dry crust is present.

The treatment recommended above will also serve here.

THE SARCOPTIC MANGE OF THE OX.

A general statement in the books is that there is no separate *Sarcoptes* variety affecting the ox. The presence of a *Sarcoptes* on the ox is said to be accidental and due to trans-

mission from the horse or from the goat. Almost certainly this opinion is wrong. I have a record of Sarcoptic attack on dairy cows, where the scab-mite had passed to and rather severely affected the arms of the cowman. Mr Garnett, President of the Royal College of Veterinary Surgeons, has informed me in conversation that *Sarcoptes* attack on cows is quite familiar to him, and Mr A. W. Noël-Pillers has produced strong evidence in favour of Sarcoptic mange being the common mange of housed cattle. In the past year I have examined microscopically many hundreds of *Sarcoptes* mites that were taken from cows, the commonest place for them being the root of the tail. Mr Noël-Pillers¹ mentions also the "hinder aspect of the mammary gland," notes "in many cases a falling off in the milk," in addition to ordinary mange lesions, and recommends for treatment "isolation of the affected animal, the removal of as much scab as possible, and then a dressing with

Sulphur	.	.	:	:	1 part
Vaseline or fish oil	.	.	:	:	4 parts."

Wash off in a week and dress again. Two points are worthy of note—viz., the relation between the dressing used and contamination of the milk, and the fact that the mange may pass to attendants.

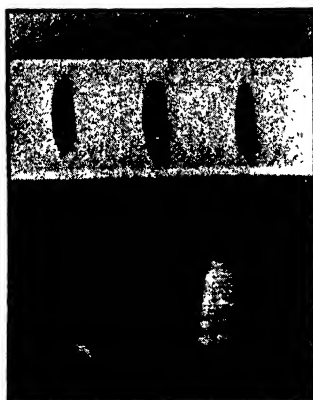


Fig. 64.—Three *Eumerus* larvæ (above); Empty puparium (left) from which adult *Merodon equestris* has issued; larva of *Merodon* (right).

From nature.

NARCISSUS FLIES.

Two troublesome enemies of Narcissus and other bulbs came to me in December from Edinburgh in the bulb of *Narcissus poeticus*, the Pheasant's Eye—viz., the larvæ of *Merodon equestris*, the Large Narcissus Fly, and of *Eumerus strigatus*, the Small Narcissus Fly. One bulb contained three *Eumerus* larvæ and one *Merodon* larva (Fig. 64). In past years I have bred a number of *Merodon* adults from infested Narcissus bulbs.

Merodon equestris.—The larva of this fly is found in Narcissus bulbs, and as a result the bulb may be so spoiled that it rots away, or, in other cases, weakened plants and flowers may be produced but no new bulbs. It is often difficult to say without opening the bulb that a *Merodon* grub

¹ Wallace-Hoare's System of Veterinary Medicine. Vol. ii. p. 1466.

is present, but in cases where the grub has been at work for a considerable time its presence can be recognised by the bulb "giving" on being squeezed between finger and thumb. Mr J. C. F. Fryer,¹ on the authority of a leading grower, states that the bulbs of *Narcissus maximus* and *N. spurius* varieties are least attacked, and that *N. poeticus* and *N. Leedsi* varieties are the most susceptible varieties (Fig. 65).

In addition to their presence in bulbs of the genus *Narcissus* the larvæ have been recorded from bulbs of *Amaryllis* (by Adams), *Habranthus* (by Chittenden), *Vallota* (by Chittenden and Theobald), *Eurycles* (by M'Lachlan), *Lilies* (by Wilks),



Fig. 65.—*Narcissus* bulb cut open to show *Merodon* larva.

On the right a bulb showing damage at base where the adventitious roots are borne.
Figures natural size, and from nature.

Galtonia (by Theobald), and the Wild Hyacinth (by Theobald). Fryer also names the cultivated Hyacinth, *Leucojum*, the Snowflake, and rarely the Tulip.

The larvæ are often distributed in infested bulbs, and in this way have been carried across the ocean to other continents. In Scotland the larvæ have been found at work from Elgin southwards to Dumfries.

The larva is a legless grub, and when full grown and extended measures $\frac{1}{2}$ to $\frac{3}{4}$ inch in length. The body is stout and rounded. At the front end, on the under surface, are the dark mouth-hooks, and at the hind end is a dark horny projection on which

¹ Journal of the Board of Agriculture and Fisheries for May 1914, p. 136. See also Board of Agriculture and Fisheries Leaflet 286.

the hind breathing pores are situated; examination with a good hand-lens will reveal a small spine on each side of the dark hind projection. The colour of the larva is grey-yellow.

The pupa-case (fig. 64) is dark coloured and marked externally by a transverse ringing; the dark projection can be seen at the hind end.

The mature flies are active in sunshine in spring and summer. Fryer,¹ from observation, describes the egg-laying thus: "The fly first spends some time in moving from one part of a Narcissus bed to another, settling repeatedly on the foliage or on the ground, thoroughly exploring its surroundings. Finally, it crawls to the centre of a plant, where not infrequently is a hole $\frac{1}{2}$ inch in diameter passing from the surface of the soil down to the bulb. This hole was originally filled by the leaves and stems of the Narcissus, but when the foliage dies down and shrivels an open shaft is left. On finding such a hole, the fly backs down until its head may be below the surface of the soil. An egg is then laid, usually on the earth forming the side of the hole, less frequently on the leaves near the neck of the bulb. If the hole is blocked by earth or by the leaves of the Narcissus the egg may be placed on the earth at the edge of the hole in any crack in the soil, or, as happened on several occasions, under heaps of earth lying near. No eggs were found on the foliage above ground."

The full-fed grub may pupate in the spoiled bulb, but more generally in the soil.

*Treatment.*²—1. Careful examination of the bulbs at the time of lifting, and also in case of importation, before planting, with the destruction of bulbs that are decayed and infested. Infested bulbs have not, on pressure with the fingers, the firmness of sound bulbs.

2. Steep the bulbs in slightly warmed water for a day or two; this drives a considerable proportion of the larvæ out of the infested bulbs.

3. Remove from the beds bulbs and plants that are failing, and destroy them.

Eumerus strigatus.—This is a distinctly smaller and less bulky fly than Merodon, and the larvæ have not the rounded barrel-like appearance of Merodon. The extended full-grown larva may reach $\frac{1}{2}$ inch in length; the colour of the larva is greyish-yellow; by means of a lens the brown mouth-hooks can be

¹ Further Notes on Narcissus Flies, by J. C. F. Fryer, M.A., in 'Journal of Board of Agriculture and Fisheries,' August 1914, p. 424.

² Narcissus Flies, by R. Stewart MacDougall, in 'Journal of Board of Agriculture and Fisheries' for October 1913, p. 594. In this article a general account is given.

made out, and also at the hind end a very characteristic chestnut-brown projection ending in the breathing pores, and on each side of this a spine.

The female lays a number of eggs in the neighbourhood of the bulb, therefore several or a number of *Eumerus* larvæ may be found in one bulb with the result that the bulb is quite destroyed.

In addition to *Eumerus* being found in bulbs of *Narcissus*, Theobald and others have found them in hyacinth bulbs. On the Continent there are records of attack on the bulbs of onion and shallot.

THE BLACK VINE-WEEVIL (*Otiorrhynchus sulcatus*).

This is a common enemy, both as adult and as larva, to plants under glass. The adult weevils browse at night on the leaves, and the larvæ feed at the roots (Fig. 66). With pot-plants that are going off it is not uncommon to find a large number of these larvæ on the plant being shaken out. This year complaint was made to me of attack on cyclamen plants which were being killed.

The weevil is $\frac{3}{8}$ inch in length. It is black, but the clubbed antennæ are reddish. The short rostrum has a deep furrow on its upper surface (use a lens). The front part of the body has grey-yellow hairs, and the wing-covers patches of yellowish hairs. The weevil cannot fly. The larva is a typical weevil grub; legless, with brown head and biting jaws, and with curled, wrinkled body; the colour is yellow-white, with brown hairs.

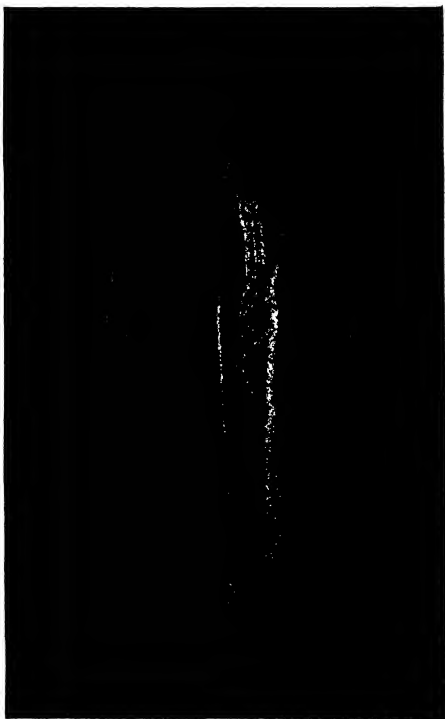


Fig. 66.—Damage to *Begonia* by *Otiorrhynchus sulcatus*.

Natural size. (Original.)

Treatment.—(1) Sacking placed beside the food-plants, or bands of hay twined in them, should be prepared as traps for the adults, which use them as shelter places in the daytime.

(2) Shake the weevils down at night on to tarred boards or cloths.

(3) Incorporate naphthalene or vaporite with the soil as a measure against the grubs.

THE DEATH'S-HEAD MOTH (*Acherontia atropos*) (Fig. 67).

In the 'Transactions' of 1913 I gave some notes on this moth. Now I have to mention it again, but in a different connection—not as an enemy on potatoes, but as an invader of beehives. The moth sent to me as taken from a hive in Kirkcudbrightshire was a mere skeleton. The hive was that of a weak Italian stock. On the hive being opened the moth had been found lying between two well-filled combs, and had the appearance of having been dead for some time. The owner had opened the hive in mild



Fig. 67.—*Acherontia atropos*.

From nature.

weather in March owing to doubts as to the condition of the bees (as a matter of fact the stock was found dead), and it was then that the Death's-Head Moth was found. The moth, as it reached me, had lost its hair and scales, and was hollowed out, and had a dead bee lying in the skeleton of the abdomen. The Death's-Head Moth is too rare in Britain to be a serious enemy (I have had single specimens from Cromarty to Roxburgh and Kirkcudbright); but in countries—*e.g.*, Italy—where in some places it is common, it is looked upon as a troublesome

enemy of bees. The moths force their way into hives and gorge themselves on the honey. It has been denied that the Death's-Head Moth enters hives to steal honey, but the records are too complete for this habit to be doubted. Observers in Britain or in Continental countries have found the moths flying round hives, crawling over hives, and actually inside hives. Moths have been taken emerging from hives with their wings and legs covered with bees, the moths sometimes so gorged with honey that they were unable to fly. In other cases the bees, unable to turn out the intruder, have been known to surround the imprisoned moth with a complete covering of wax.

THE POPLAR HAWK MOTH (*Smerinthus populi*).

A male and female, in copula, of this species came to me on June 28. The moth is a common one, and attracts attention from its size; its caterpillar feeds on poplar, willow, and some garden plants, but is not at all a serious enemy. Moth and caterpillar will easily be recognised from the following description:—

Moth.—The moth is stout-bodied, and is up to $1\frac{1}{4}$ inch long; in wing-spread it measures from less than 3 inches up to $3\frac{1}{2}$ inches. The wings are distinctly notched at the margin. The front wings are brown or grey-brown, with darker brown here and there; about the middle of each front wing is a white spot. The hind wings resemble the front wings, but have at their base a distinct red or red-brown blotch; there is no central white spot. The moth flies in June and July.

Caterpillar.—Green, with many yellow dots; there are seven oblique yellow stripes on each side; sometimes there is a row of red dots high up along each side; spiracles red, or in some cases light-coloured, edged with brown; skin rough and granular; from the upper surface of the second last joint there projects a green or yellow-green horn, with red base. Length of caterpillar 3 to $3\frac{1}{2}$ inches.

THE GHOST SWIFT MOTH (*Hepialus humuli*).

This insect, on which I gave some notes in the 'Transactions for 1913, was again sent to me this year from field and garden. The 1913 notes recorded the caterpillar as injurious in a bed of two-year seedling ash. The caterpillars, however, are typically enemies of herbaceous plants. In one case the Swift Moth caterpillars came in hollowed-out roots of dockens (one of its

food-plants); the dockens, which were being pulled in a two-year-old lea park, had "big heads of seed coming on" in spite of the caterpillars.

THE TURNIP, MUSTARD, and CABBAGE FLOWER BEETLE
(*Meligethes cæneus*).

From Fife, in the month of June, stalks and flowers of Charlock (*Sinapis arvensis*) and Runch (*Raphanus raphanistrum*) were sent to me, taken from a field where these two weeds were rather plentiful. The flower heads contained numbers of adults and grubs of the above-named beetle. My correspondent made a careful examination of the flower heads, and found relatively few with seeds owing to *Meligethes* destroying the flowers.

In this case *Meligethes* was doing useful work, but unfortunately the beetle does not confine its feeding to cruciferous weeds, but has proved on numerous occasions troublesome in the flower heads of cultivated crucifers, hence the common name of the beetle.

The beetle is little more than $\frac{1}{2}$ inch long. It varies somewhat in colour, but typically is brassy green or deep green, with the thighs darker.

The grub is jawed, has six walking legs, and also at the hind end of the thorax a muscular projection of service in locomotion. In colour the grubs are yellowish or greyish-white, with dark heads.

The beetles lay their eggs in opening buds; the full-fed grub falls away from the spoiled flower and enters the ground to pupate.

THE GARDEN CHAFER or SMALLER JUNE BUG or BRACKEN CLOCK
(*Phyllopertha horticola*).

In March larvæ of this beetle were sent to me from Auchencruive, where they were at work at the roots of a lawn of very old grass. The letter accompanying the specimens said: "The first indication that anything was wrong was about the month of October last (1914), when the crows began to tear up large portions of the lawn. Since October the crows made no further attempt to tear up the lawn until yesterday (March 7, 1915). On examination the grubs now sent were found in large numbers."

Once before I gave a note in the 'Transactions' on the damage done by the grubs on grass land. In that case grass and clover suffered, the roots being bitten through. The grubs were on old lea and natural dry knolls, and their presence was

recognised by the colour of the withered grass,¹ and by the working of birds in search for the grubs. Cattle walking over infested patches in wet weather sank two or three inches in the soil and made a mess of the land. On dry sloping ground the soil was soft and fine under foot, as if it had been harrowed, only a few of the deeper-rooted grasses having kept their hold. From the grubs I bred out the beetles in May (in the Laboratory).

The adult beetle measures $\frac{1}{3}$ inch long, or slightly over; the head and thorax are glossy blue-green, and the wing-covers yellow-brown or red-brown; the body is hairy.

The larva is a 6-legged grub, yellow-white in colour, fleshy, and wrinkled; examined with a hand-lens the brown jaws, black at the top, will be seen, and also the two minute antennæ. This type of larva just described is characteristic of a family of beetles, some of which—*e.g.*, the Cockchafer in their young and partly-grown larval stage—may be confused with the larva of the Garden Chafer. In the larva of the Garden Chafer, however, the claws of the front pair of legs are shorter than those of the second pair, and the claws of the second pair shorter than those of the third pair; further, if the mandible of the Garden Chafer be dissected out, cleared, and placed under the microscope, a small oval patch will be seen with file-like ridges running across it.

Habits of Phyllopertha.—The beetles love sunshine and are sometimes found in large swarms. The adult beetles eat the leafage of orchard and other trees; they destroy both leaves and flowers of roses; fruits also are attacked. I have in my Museum a number of young apples, collected on the Continent, with pieces eaten out of them by the beetles; Theobald² records similar damage to apples in Surrey.

The females lay their eggs in the soil and the grubs gnaw the roots of grass especially, and clover, cabbage, and other garden plants.

Treatment.—The beetles should be collected at swarming time. In the early morning when the beetles are sluggish the plants on which the beetles are resting should be shaken, and the falling beetles caught on cloths spread for the purpose. In a garden an inverted open umbrella is a useful trap into which the beetles can be shaken. In low plants the beetles can be shaken into a dish containing some paraffin.

The grubs are difficult to reach, and especially they can continue harmful on a lawn or permanent pasture when there is no ploughing up of the land with accompanying destruction of grubs. There is room for experiment with naphthalene on

¹ See also *Farm Insects*, by Curtis. 1860. P. 220, &c., and p. 509.

² Report on Economic Zoology for 1912, p. 15.

the lines of the experiment quoted in my last year's notes on the Daddy-Longlegs¹ as under the observation of the Board of Agriculture and Fisheries—viz., broadcasting naphthalene at the rate of from one to two cwt. per acre subsequently ploughed or harrowed in, or on a lawn, scattering the naphthalene over it and then washing it in by a stream of water from a hose.

BARIS LARVÆ IN CABBAGE STEMS.

In the first week of July a number of cabbage plants from a seed-bed were sent to me from Mid-Lothian. The sender is an experienced grower and observer, and had never before noticed similarly attacked cabbage. On the stems of the drooping plants being cut open for examination numbers of the larvæ of a weevil were found; it was the tunnelling of these larvæ that had caused the plants to fail. In the second week of July a consignment of plants from the Brassica seed-bed reached me from Cumberland, and the disease here was also due to the same weevil grubs, many of which were found actively at work. At the end of July a further consignment of damaged plants reached me. My correspondent in Cumberland described the insect as an annual pest.

I did not succeed in rearing the adults, although I kept larvæ in cabbage stems right to the end of August. As far as I know this is the first record of such damage in Scotland. The late Miss Ormerod recorded similar damage to cabbage in 1892² in specimens received from Wexford, Ireland. I recorded on June 21, 1906, for the Board of Agriculture and Fisheries, this same damage to young cabbage from Maryport, Cumberland (in this case by June 21 50 per cent of the crop had been destroyed), and in 1907, also for the Board of Agriculture and Fisheries, on June 26, attacked cabbage from Witham, Essex. Professor Theobald³ recorded the damage in 1912 from Devon and Cornwall. Professor Carpenter⁴ recorded in 1913 the same damage on cabbage and cauliflower from County Clare.

The eggs were laid by the weevils upon the plants in the seed-bed, and in transplanting, the plants were carefully examined because of this enemy, and any plants showing the tiny holes in the stem were rejected. Writing at the end of July my correspondent said, "the plants most affected this year have been Cauliflower, Curled Greens, and Mid-season

¹ Transactions of the Highland and Agricultural Society, 1915.

² Report of Observations on Injurious Insects, by the late Miss Ormerod, 1892, p. 23.

³ Report on Economic Zoology for year ending September 30, 1912, by Fred V. Theobald, M.A., F.E.S.

⁴ The Economic Proceedings of the Royal Dublin Society, 1913, by Professor G. H. Carpenter.

Savoys, with some kinds of Broccoli coming close behind, then Early Table Cabbage (for use in autumn). The least affected have been Asparagus Kale and Early Savoys."

On dissection of the infected plants I found the *Baris* grubs (see Fig. 68) numerous, and often in nests of five and six and

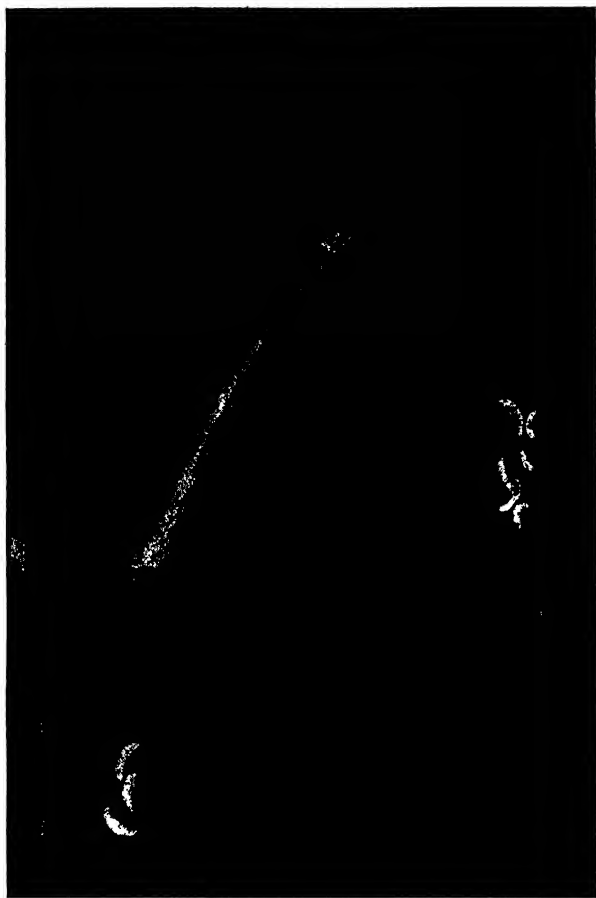


Fig. 68.—*Baris* larvæ in their workings in cabbage stem.

From nature. Natural size.

seven. The larvæ are legless, but were distinctly active. They were of different sizes—some quite small and others well grown. I never got the larvæ lower than the place where the seed-leaves come off, but the stem was tunnelled from this level all the way to the apex. The hollowed-out centre of the stem held a yellow-brown frass.

The larvæ were also present in the leaf-stalks, several larvæ to a gallery. In some cases the midrib of the leaf was also tunnelled, the grubs being found at work (Fig. 69).

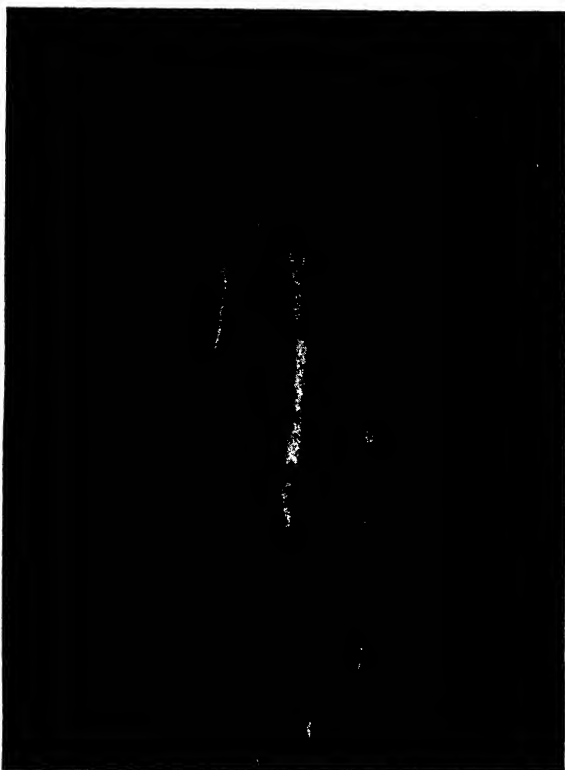


Fig. 69.— *Young cabbage plants infested by Baris larvæ.*

The central plant is seen to be drooping; in another plant the stem is split, this taking place after the stem has been tunnelled; the small round holes are signs of the presence of the larva. From nature, reduced.

Indications of the presence of the pest were—

- (a) Minute holes here and there along the central stem, showing as round dark spots.
- (b) The yellowing of the leaves of the young plants, due to the galleries in the centre of stem and the boring in the cortex.

The borings in the leaf-stalk and in the midrib caused the change of colour and withering of individual leaves.

In some of the galleries a parasitic Chalcid larva was present, feeding on the Baris grub. The Chalcid attached itself to the outside of the Baris grub, which in time was killed. On dis-

secting some cabbage stems on August 30, in search for pupæ of *Baris*, I found several Chalcid cocoons, and here and there in the hollowed stem, alongside the Chalcid cocoons, the brown horny heads of *Baris* grubs that had been destroyed by the parasite. The *Baris* larvæ are legless, with pale-brown heads; the tips of the jaws are darker.

As regards treatment, plants should be carefully revised in the seed-bed and at transplanting, and infested ones destroyed.

The Mid-Lothian specimens were also attacked by the larvæ of the Cabbage Root Fly (*Phorbia brassicæ*). Some of the Cumberland specimens contained the larvæ of the Cabbage Root Fly, and also, in the leaves, the mining maggots of the fly *Phytomyza flavicornis*; the *Phytomyza* maggots pupated in the soil, the adults issuing in due course.

THE BEAN APHIS (*Aphis rumicis*, L.).

This is in some seasons a perfect scourge on beans—garden beans and field beans. It feeds in one or other of its stages on a very large number of totally distinct plants, and therefore appears in the literature under a number of different names. It is only recently that proof has been afforded that a number of Aphids, till now regarded as separate species, are really all referable to *Aphis rumicis*.

The life-history of *A. rumicis* is complex, not being completed on a single plant. Migrations from one plant to a plant of another kind take place. Only once in the course of the year, and that towards and in autumn, are sexual males and females found. From a pairing of these, fertilised eggs are laid; these eggs over-winter, and in spring females develop from the young that hatch from these eggs, and during spring and summer a number of virgin female generations are produced, some of them wingless, some of them winged. A number of points in the life-history that were obscure have recently been cleared up by the observations and experimental work of Theobald¹ and Davidson.²

Theobald showed that there were two possible and, as it seemed, separate life-cycles of *A. rumicis*, which here we shall name A. and B.

In A., eggs which had over-wintered on the Spindle Tree (*Enonymus*) hatched in spring, and gave rise to adult females, which were the progenitors of a migrant generation of winged

¹ The Aphides of Mangold and Allied Plants, by Fred V. Theobald, M.A., F.E.S., in the 'Journal of the Board of Agriculture and Fisheries' for September 1912, pp. 466-476.

² The Host Plants and Habits of *Aphis rumicis*, L., with some Observations on the Migration of and Infestation of Plants by Aphides, by J. Davidson, M.Sc., F.E.S., in the 'Annals of Applied Biology.' Vol. I., No. 2, July 1914.

females which flew to poppies, and in some favouring years to mangolds and beet; in autumn descendants of these migrated to the Spindle Tree, and gave rise in late autumn to a generation of males and females. After pairing, fertilised eggs were laid on the Spindle Tree, and in this egg stage the winter was passed.

In B., eggs which had over-wintered on Dock hatched in spring, and gave rise to adult females, which were the progenitors of a migrant generation of winged females which flew to beans, and gave rise on the bean to the notoriously troublesome generations of Bean Aphides. In autumn a migration took place from the Bean to the Dock; the migrating generation gave rise in late autumn to a generation of males and females. After pairing, fertilised eggs were laid on the Dock, and in this egg stage the winter was passed.

Davidson experimentally has shown that these two cycles are not mutually exclusive, but that the migrants from the Spindle Tree will pass to and multiply on Bean, and that the Aphid on the Spindle Tree, if placed on Dock, migrates to and multiplies both on Beans and Poppy.

Without quoting the long list of plants that *A. rumicis* can infest, it will be enough to say that besides dockens thistles can act as the host plant.

Treatment of the Bean Aphid.—The important point to notice is that one should be lying in wait as it were for the first sign of infection of the bean. The infected tops should then be cut off and destroyed. At this time a very satisfactory spray is one of soft soap and quassia made thus¹:—

Dissolve 5 lb. of soft soap in 100 gallons of soft water;

Boil 6 to 8 lb. of quassia chips in water and add the extract to the 100 gallons of wash.

THE WHITE WOOLLY CURRANT SCALE (*Pulvinaria vitis*, var. *ribesiae*).

This scale insect (see Fig. 70) was brought to me on June 9, when it was very conspicuous owing to the white woolly-looking egg-sacs at the hind end of the bent-upward insect. The scale was present in fair numbers on the Flowering Currant (*Ribes sanguineum*). In the same month specimens of this scale came to me from the species *Ribes hirtellum*. This scale insect may be found on a large number of trees and shrubs of quite different Natural Orders; with us it is specially an enemy of the genus *Ribes*, and all three kinds of cultivated currants—red and white, and especially black—suffer from this attack.

¹ Leaflet of the Aphides. No. 104 of the Board of Agriculture and Fisheries.

*Life-history.*¹—This pest is most prominent in the summer time, when the egg-sac is present. The eggs hatch in June and July, and the larvæ from the eggs scatter over the food plant. Several moults take place, associated with the development and growth of the insect.

The male in the course of its development passes through a resting pupal stage, but such a stage is not present in the female. The females far outnumber the males. In autumn the scales are adult, and if males be present pairing takes place. The fertilised female passes the winter attached to the bark of the plant, and at this time is not very conspicuous. Examined from above, we see an oval scale, $\frac{1}{16}$ th inch long and over, yellow-brown in colour, with a dark-brown network pattern, and a notch at the hind end. By and in May, from glands on the under side of the insect a mass of white waxy threads have been secreted (Fig. 70) at the hind end. As this waxy, wool-like egg-sac increases, the hind end of the scale (*i.e.*, of the female insect) is raised up from the bark and the appearance is that shown in the figure. Eggs are laid in large numbers, and these hatch in June and July, a new cycle beginning.

Treatment.—Destroy the scales in the winter stage by spray-



Fig. 70.—*The white woolly currant scale.*

From nature. Natural size.

¹ A complete account of this scale, with plates, is given in the 'Monograph of the British Coccidæ,' by Professor R. Neustead, F.R.S. The Ray Society, 1902. Vol. ii. pp. 55 to 67.

ing with paraffin emulsion, or with the caustic winter wash, known as the Woburn wash.

The formula for the Woburn wash¹ is:—

Iron sulphate	1 lb.
Lime	1 lb.
Caustic soda	2 lb.
Paraffin (solar distillate)	5 pints.
Water	10 gallons.

Dissolve the iron sulphate in about 9 gallons of water. Slake the lime in a little water and stir well, a little more water being added to form a "milk." Next, run the "milk of lime" into the iron sulphate solution through a piece of sacking or a fine sieve, to keep back grit or coarse particles. Next, add the paraffin and churn thoroughly. Just before using add the caustic soda in powdered form.

Such a wash should only be applied to plants when the plants are in a winter resting or dormant condition. The wash is a caustic one, and therefore the face and hands of the worker need protection. Further, repeated use of such a wash injuriously affects the plant, therefore winter washing with this caustic wash should not be an annual operation.

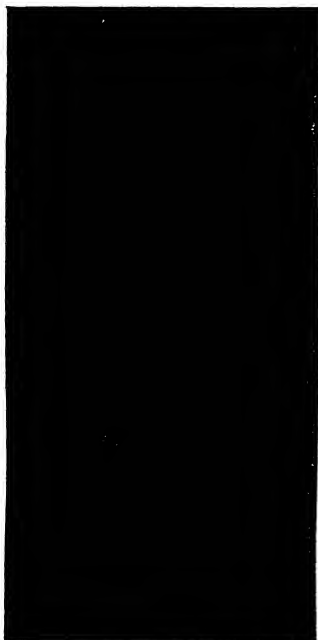


Fig. 71.—Young ash tree with leaf eaten by the blister beetle.

Half natural size. From nature.

THE BLISTER BEETLE OR "SPANISH FLY" (*Lytta vesicatoria*).

This is a rare beetle in Britain; it is not found in Scotland, but in some years can be captured in the south and south-eastern counties of England. Live specimens of the beetle were sent to me last June from Norfolk, where some fifty adults were found all together in a brake of young ash.

The adult beetles are gregarious, and in South-western Europe appear suddenly in great numbers in summer, swarm over the trees on whose leaves they feed (Fig. 71), and disappear with the same suddenness.

¹ Leaflet No. 70 of the Board of Agriculture and Fisheries describes the winter washing of fruit trees.

Lytta vesicatoria measures from $\frac{1}{2}$ to $\frac{3}{4}$ inch in length. It is elongate and parallel-sided, and is bright metallic green or brown-green in colour (Fig. 72). The beetle gives off a distinct odour. Its life-history is very complex, the larva passing through more than one form, while the food habit varies with the form of larva; in its early form the larva is parasitic in the nest of a bee.

Even in the countries in which *L. vesicatoria* can be found in numbers it has only a slight forest importance. The chief food plants of the beetle are Oleaceous plants—Ash and Lilac and Privet and Olive; other plants are taken, Poplar, Acer, Rose. The chief interest of the beetle is its medicinal importance. The beetles are collected—they should not be rashly handled—dried, and sold, because of their possessing powerful vesicant or blistering properties. The powdered bodies of the beetles form the cantharides of the pharmacist. The extract cantharadin is a white crystalline compound which, applied externally, produces blisters, and, taken internally, is an irritant poison. At present the beetles are selling at about 17s. per lb. and the powder at 18s. per lb.



Fig. 72. — *The blister beetle.*

Natural size From nature.

THE WILLOW AND ALDER BEETLE (*Cryptorhynchus lapathi*).

This weevil was recorded two years ago from Deeside, Aberdeenshire, by Mr James Munro, B.Sc., who gave me willow material injured by the insect. In the past year further spoiled willow has been brought to me by Mr Walter Ritchie, B.Sc. In both of these cases *Cryptorhynchus* was taken in old willows by the riverside; these willows had no actual forest importance, but they serve as centres from which the weevil might spread.

This weevil¹ measures about $\frac{1}{2}$ inch long; it is dull black or black-brown in colour, with chalk-white or yellow-white scales on the hind part of the wing-covers, the thighs, and the front part of the thorax. The beetle has a distinct snout or proboscis, but when the insect is resting the snout cannot be seen from above owing to its lying bent under the thorax. The larva is a legless grub, with white-yellow body and brown head and mouth parts.

The female weevil lays her eggs on or in the bark. The larva on hatching tunnels just below the outside bark, making, to begin with, a straight gallery or tunnelling round so as to almost ring the branch; later, the larva goes into the wood. The larval galleries are full of bore dust, and the projecting sawdust and small chips indicate, as well as the change of colour of the bark

¹ The Alder and Osier Weevil (*Cryptorhynchus lapathi*), by R. Stewart MacDougall, in 'Journal of Board of Agriculture and Fisheries,' June 1911.

at the place of entry, the presence of the insect. The full-grown grub pupates at the end of the larval boring. Later, the round exit holes made by the beetle and sunken patches in the branches call attention to the work of the insect. In addition to larval damage, the adult gnaws the tips of shoots and the bark of branches.

Treatment.—Infested stems should be removed, and attacked branches cut away and burned.

PISSODES PINI.

From different counties in the north of Scotland examples of this weevil were sent to me, and the insect was also found actively at work on Pines in Mid-Lothian and East Lothian.



Fig. 73.—*Hylobius abietis*.

Magnified. From nature. The natural size of the beetle is on the average $\frac{1}{3}$ to $\frac{1}{2}$ inch.



Fig. 74.—*Pissodes pini*.

Magnified. From nature. The natural size of the beetle is on the average $\frac{1}{3}$ inch.

This is the largest British species of the genus *Pissodes*, and is sometimes confused with *Hylobius abietis*,¹ not only in the adult stage when distinction is very easy, but also in the larval stage when there can be confusion for not only the grubs of *Hylobius abietis*, but also those of *Pissodes pini* may be found working in pine stumps left after the trees have been felled.

In reply to difficulties, I contrast here in different ways the two insects:—

ADULT *H. ABIETIS*.

Antennæ inserted near apex of proboscis.

(See Fig. 73).

A tooth-like projection from the thighs.

ADULT *P. PINI*.

Antennæ inserted on the proboscis some distance from the apex.

(See Fig. 74).

No tooth-like projection from the thighs.

¹ See Leaflet No. 8 of Board of Agriculture for Scotland, and Leaflet No. 138 of the Board of Agriculture and Fisheries.

The larvæ may be confused, especially when they are in a young stage. Mr James Munro, B.Sc., who is researching on forest insects in my Laboratory at the University, has found the following differences excellent for separating the larvæ:—

LARVA OF *H. ABIETIS*.

The spiracles are elliptical.
The forehead shows furrows.

LARVA OF *P. PINI*.

The spiracles are circular.
The forehead has no furrows.

A good hand-lens magnifying five or six times should be used in distinguishing the larvæ.

In mode of feeding the adults of *Hylobius* bite pieces out of the bark and right into the cambium of young nursery conifers, and it may be broad-leaved species. The adults of *P. pini* at most make only minute proboscis punctures on young shoots (Fig. 75). The adults of course lay the eggs, but it is the larvæ which are destructive, as they gnaw galleries between the wood and the bark of sickly trees.

MYELOPHILUS (HYLURGUS) MINOR.

From county Aberdeen and from county Perth examples of the work of this shoot and bark-boring pine beetle have come to me. Mr Walter Ritchie, B.Sc. (researching on the *M. minor* in my Laboratory), has found in Aberdeenshire hundreds of this beetle, which proves not to be so uncommon as stated in the books.

Examples of the work of this beetle, which bores into the young shoots and under the bark of pine, have come to me from Perthshire from Mr J. A. Murray, B.Sc. The brood galleries of this pine beetle and its near ally on pines, *Myelophilus piniperda*, are very easy to distinguish. *M. piniperda*

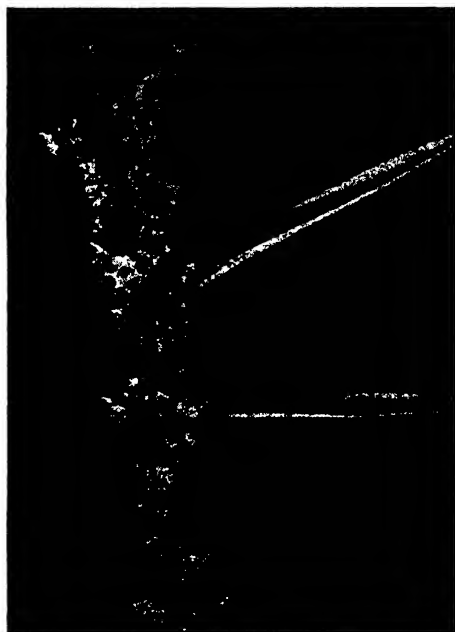


Fig. 75.—Twig of *Pinus sylvestris*, showing punctures made by proboscis of feeding *Pissodes pini*.

About 8 times magnified. From nature.

makes below the bark a gallery which is shaped like a golf club, and runs longitudinally, the larval galleries coming off at right angles to it. The mother gallery of *M. minor*, on the other hand, is a two-armed gallery which runs in the transverse direction; the larval galleries are short and run upwards and downwards from the mother gallery.



Fig. 76.—Gall on willow due to the sawfly *Cryptocampus medullarius*.
From nature. Natural size.

EUURA PENTANDRÆ, Cameron; CRYPTOCAMPUS MEDULLARIUS,
Hartig (C. PENTANDRÆ).

Twigs of willow covered with galls (Fig. 76) were sent to me in February 1915 from the West of Scotland. The hard woody galls contained full-grown larvæ (slate-coloured in their last larval stage), and some received a little later contained slate-coloured pupæ. The galls are caused by the above-named saw-

fly, which saws in summer holes in the shoots in which the eggs are laid. The caterpillars from the eggs pass the winter in the gall and pupate there in time for the issue of the adults in summer. With the artificial temperature in the Laboratory the adult sawflies issued from the galls in April and May—i.e., sooner than usual. When the galls are very numerous on the tree death of the tree may follow.

HOUSEHOLD INSECTS.

TINEOLA BISELLIELLA.

This is one of the clothes moths whose caterpillars do not form a protective case of the material in which they are feeding, but spin silk as they move about, and when they are full-grown spin a cocoon of silk under cover of which they pupate. In addition to the caterpillars feeding on woollen and fur material and hair and feathers, they show a distinct liking for animal food—e.g., they have proved destructive to collections of moths. Mr J. Hartley Durrant of the Natural History Museum has reared the moths in large numbers from pemmican. I have reared from the egg stage to the adult two separate broods on dog-biscuit. Dog-biscuit contains in it some flesh. Isolated adults were experimentally offered such biscuit as material on which eggs might be laid, and, as stated above, eggs were laid on the broken biscuit, and the caterpillars on hatching fed and completed their development; cocoons were spun, and a new generation of adults issued. In this experiment the insects had no choice of different food materials, only dog-biscuit being offered to them. On this material, and in the same conditions, the caterpillars thrived far better than in another experiment where fur and woollen material was offered to them.

Last summer a jar of casein was sent to me containing caterpillars of this moth. The casein had been made for laboratory purposes, and during a chance temporary removal of the cork eggs had been laid on the exposed casein. The caterpillars flourished on the casein, and I was able by autumn to breed out a large number of the moths. Casein is a preparation from milk, and has various uses—e.g., as an ingredient in and for coating paper.

NIPTUS HOLOLEUCUS.

From another source came, curiously enough, another insect-infected supply of casein. In this case the enemy was a beetle named *Niptus hololeucus*. The beetles are shown in Fig. 77. I have had the material for some months now, and the beetles seem quite at home. This beetle may be described as a fairly common one in houses, specimens being sent to me for deter-

mination every year. It is found among old wood, cupboards, drawers, and may be said to be a general feeder. At first sight it is apt to be mistaken for a spider—more than once it has been brought to me as a spider—because of its swollen rounded abdomen and the seeming absence, when looked at from above, of the typical three insect divisions of the body—head, thorax, abdomen.

Niptus hololeucus measures only 3 to 4 mm. in length. Fresh specimens look yellow or yellow-brown in colour owing to the

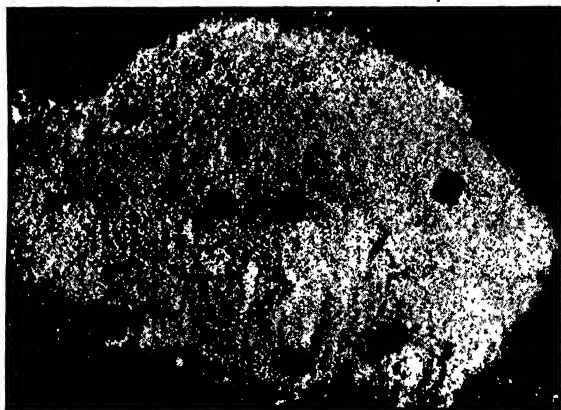


Fig. 77.—*Niptus hololeucus* on casein.

From nature. Natural size.

body being covered with a silky scale-like pubescence amid which longer hairs stand up. If the pubescence be rubbed off the beetle is seen to be dark coloured. The beetle is wingless.

THE TAPESTRY MOTH (*Trichophaga tapetiella*).

This moth issued in the summer in considerable numbers from stored deer-hides. The caterpillars feed on carpets, upholstery, and hairy skins into which they tunnel. *Trichophaga* is larger than the other clothes moths and has a more variegated appearance; the front wings are dark at the base, the apical half being yellow-white with grey streaks; the hind wings are uniform light grey and have long fringes. The head carries a tuft of white hairs.

THE GERMAN COCKROACH (*Ectobia* or *Phyllodromia germanica*).

Cockroaches are known in Britain as Black Beetles, but they are not black, neither are they beetles. They belong to the same order of insects as crickets and grasshoppers and locusts,

Ectobia germanica, like other cockroaches, may be found in the open, but it has become more or less parasitic on civilisation, and is found abundantly indoors. The insect has been sent to me in all stages—egg-cases, young, adult males and females.

The females lay their eggs in cases or capsules; these cases can be seen projecting from the body of the females, because they are carried about for some time before being deposited for the hatching of the eggs. From the eggs come young cockroaches which resemble the parent in form, but they are wingless and sexually immature. The winged mature stage is reached after a series of moults.

Ectobia germanica is easily distinguished from the other introduced species the Oriental Cockroach, the American Cockroach, and the Australian Cockroach, by its smaller size and by the colouration. The length of the body varies from 11 mm. to 13 mm. The body is light brown in colour, and there are two dark-brown longitudinal bands on the upper surface of the thorax.

The insects hide in the daytime and come out to forage at night; their flattened bodies enable them to find shelter in cracks where they are unobserved. In diet they are omnivorous; comestibles are fouled by the excrement of the insects and spoiled by the unpleasant odour that attaches to them.

To rid a place of cockroaches effort must be persistent, and specially so against *Ectobia germanica*, which multiplies rapidly. The usual cockroach remedies are—

1. *Trapping*.—Apart from specially built traps a convenient mode of catching the insects is to arrange at night bowls or steep slippery-sided basins or tins containing some sweetened liquid—e.g., stale beer; small pieces of wood are arranged as planks stretching from floor to top edge of basin or tin so that passage to the bait is easy; the cockroaches that enter the bowl or tin are unable to get out again. The trapped cockroaches should in the morning be dropped into boiling water (an instantaneous death).

2. The persistent use of borax or fresh pyrethrum powder dusted about the “runs” of the cockroaches at night.

3. Mix together a little sweetened flour and plaster of Paris—4 parts flour and 1 part plaster of Paris—and have beside it a shallow dish containing water. The insects eat the flour and plaster of Paris, then drink the water.

THE HOUSE CRICKET (*Gryllus domesticus*).

This insect was sent from glass-house and from store, but for determination only and not because of damage done. House crickets, however, can be troublesome in houses.

FOOD OF BIRDS IN RELATION TO AGRICULTURE.

By PROFESSOR A. N. M'ALPINE, Glasgow, Consulting Botanist to
the Society.

IN 1896 John Gilmour of Montrave published in the 'Transactions' of the Society the results of his investigations into the relation of certain birds to the agricultural interest as shown by their diet. This pioneer investigation, dealing chiefly with rooks, starlings, and wood-pigeons, has stimulated more extended inquiry into the matter. It is proposed in this paper to summarise the chief agricultural points embodied in the recent valuable reports on the food of birds contributed to the 'Transactions' by Laura Florence, M.A., B.Sc., of the University of Aberdeen.

Nature of the Food of Birds.—The bodies of birds, like the bodies of other living beings, require to be built up by the utilisation of special materials called foods. These foods are derived from (1) animal bodies and (2) plants. Now, among the animals used as food by birds, insects are of special interest to the farmer, for it often happens that insect destruction would mean much higher yield of crop and more profit. From a practical standpoint the farmer wants to know which are the birds that scourge the insect pests and at the same time interfere least with his crops. These insect-destroying birds are enumerated below under the heading *Insectivorous Birds*. Other birds feed on plants, on crops and weeds. Among these are found the birds most disliked by the farmer, at least so far as they tend to diminish his crops. To keep them away he uses guns, scarecrows, tin cans, and rattles of various sorts. For convenience such undesirables are listed as *Vegetarian Birds*.

In point of fact, few birds are purely insectivorous, few are purely vegetarian. However, for practical purposes, although the two classes overlap, it is convenient to regard them as distinct in order to discriminate, in general, between the birds beneficial to agriculture (insectivorous) and those injurious to crops (vegetarian).

Certain birds have no predilection either way; they take any kind of food which offers. These are placed apart in a separate group, called here *Omnivorous Birds*.

From an agricultural standpoint the three groups of birds are :—

1. Insectivorous.
2. Vegetarian.
3. Omnivorous.

For convenience of reference, the birds belonging to each group are tabulated in alphabetical order.

I. INSECTIVOROUS BIRDS (ON THE WHOLE, USEFUL).

1. Blackbird (*Turdus merula*).
Food other than insects : Earthworms, spiders, centipedes, slugs, snails.
Cereal grains, weed seeds.
Potato tubers, turnips.
Grass.
Gooseberries, strawberries.
- Corncrake (see Landrail).
2. Curlew (*Numenius arcuata*).
Other food : Blaeberreries.
Feltie (see Thrush, Missel).
3. Fieldfare (*Turdus pilaris*).
Other food : Earthworms, spiders, slugs.
Seeds, rush heads.
Grass, turnips.
4. Landrail (*Crex pratensis*).
Other food : Cereal grains, seeds. (See also Veg. Birds.)
5. Lapwing (*Vanellus cristatus*).
Other food : Earthworms, spiders, snails.
Cereal grains, weed seeds.
Grass.
6. Meadow Pipit (*Anthus pratensis*).
Other food : Spiders.
Weed seeds, raspberries.
Missel Thrush (see Thrush, Missel).
Peewit, peaseweep (see Lapwing).
7. Plover, Ringed (*Aegialitis praticula*).
Other food : seldom used.
8. Redbreast (*Erithacus rubecula*).
Other food : Spiders.
Cereal grains, seeds.
Leaves.
Redwing (see Thrush, Redwing).
Robin (see Redbreast).
9. Snipe (*Gallinago calesitis*).
Other food : Cereal grains, seed.
Grass.
10. Starling (*Sturnus vulgaris*).
Other food : Earthworms, spiders, centipedes, snails.
Cereal grains, weed seeds.
Grass.
Potato tubers.
Flower heads.
Rowans.

11. Swallow (*Hirundo rustica*).
Other food : not used.
12. Swift (*Cypselus apus*).
Other food : not used.
13. Thrush, Missel or Mistle (*Turdus viscivorus*).
Other food : Earthworms, spiders.
Seeds.
Stone fruits (holly), rose seed (achenes).
Grass.
14. Thrush, Redwing (*Turdus iliacus*).
Other food : Molluscs.
Seeds, cereal grains, grass.
Leaves.
Stone fruits (holly).
15. Tit, Blue (*Parus caeruleus*).
Other food : Centipedes.
Cereal grains, seeds.
16. Tit, Coal (*Parus ater*).
Other food : Spiders.
Vegetable matter.
17. Tit, Great (*Parus major*).
Other food : Spiders.
Cereal grains, seeds.
18. Tit, Long-tailed (*Acredula caudata*).
Other food : Cereal grains.
Tomtit (see Tit, Blue).
19. Wagtail, Pied (*Motacilla lugubris*).
Other food : Weed seeds.
Potato tubers.
Wagtail, Water (see Wagtail, Pied).
20. Woodpecker, Greatspotted (*Dendrocopus major*).
Feeds on larvæ of wood-boring beetles.
21. Wren, Jenny (*Troglodytes parvulus*).
Other food : Spiders, vegetable matter.
Seaweed.
22. Wren, Willow (*Phylloscopus trochilus*).
Other food : Spiders.
Crustacea.

II. VEGETARIAN BIRDS (ON THE WHOLE, INJURIOUS).

23. Bullfinch (*Pyrrhula europæa*).
Seeds, flower buds of fruit trees, leaf buds.
Other food : Insects.
24. Bunting, Corn (*Emberiza miliaria*).
Cereal grains, grass and weed seeds.
Other food : Insects, snails.
25. Bunting, Snow (*Plectrophanes nivalis*).
Cereal grains, grass spikelets in flower, weed seeds.
Couch roots (rhizomes).
26. Bunting, Yellow (*Emberiza citrinella*).
Cereal grains, seeds.
Other food : Insects, earthworm cocoons.

27. Chaffinch (*Fringilla cœlebs*).
 Cereal grains, weed seeds.
 Other food : Insects, spiders.
 Earthworms, snail's eggs.
 Corncrake (see Landrail).
28. Crow, Carrion (*Corvus corone*).
 Cereal grains, seeds.
 Turnips.
 Other food : Insects.
29. Crow, Hooded (*Corvus cornix*).
 Cereal grains.
 Turnips, potato tubers.
 Other food : Insects, spiders.
 Earthworms, molluscs (whelks, limpets).
30. Greenfinch (*Ligurinus chloris*).
 Cereal grains, crop seeds, weed seeds.
 Other food : Insects, spiders.
31. Grouse, Red (*Lagopus scoticus*).
 Cereal grains.
 Young heather shoots.
 Leaves of sheep's sorrel.
32. Jackdaw (*Corvus monedula*).
 Cereal grains, seeds.
 Potato tubers.
 Other food : Weevils, earthworm cocoons.
33. Landrail (*Crex pratensis*).
 Cereal grains, seeds.
 Other food : Insects.
 Lark (see Skylark).
 Laverock (see Skylark).
34. Linnet (*Linota cannabina*).
 Weed seeds.
 Linnet, Green (see Greenfinch).
 Lintie (see Linnet).
35. Magpie (*Pica rustica*).
 Cereal grains, seeds.
 Other food : Insects (caterpillars, caddis-worms).
 Earthworm cocoons.
36. Moorhen (*Gallinula chloropus*).
 Cereals, grass, seeds.
 Other food : Insects, earthworms.
37. Partridge (*Perdix cinerea*).
 Cereal grains, weed seeds.
 Clover, grass, leaves.
38. Pheasant (*Phasianus colchicus*).
 Cereal grains, seeds
 Tuber roots of lesser celandine.
 Piet (see Magpie).
39. Pigeon, Wood (*Columba palumbus*).
 Cereal grains, seeds, peas, beans, beech-nuts.
 Clover buds, turnip tops, buttercup leaves ?
 Other food : Insects, earthworm cocoons.
 Snails and slugs.
 Ring-dove (see Pigeon, Wood).

40. Sparrow, Hedge (*Accentor modularis*).
Cereal grains.
Other food : Insects.
41. Sparrow, House (*Passer domesticus*).
Cereal grains, weed seeds.
Grass.
Other food : Insects rarely.
42. Skylark (*Alauda arvensis*).
Cereal grains, seeds.
Grass, clover leaves.
Potato tubers.
Other food : Insects, spiders, earthworm cocoons.
Waterhen (see Moorhen).
Yellowhammer (see Bunting, Yellow).
Yellow Yite (see Bunting, Yellow).

III. OMNIVOROUS BIRDS.

- Crow, Common (see Rook).
43. Gull, Black-headed (*Larus ridibundus*).
Insects, earthworms, marine worms, crustacea.
Cereal grains, seeds.
Garden fruit, blackberries
Potatoes, turnips.
Grass.
44. Gull, Common (*Larus canus*).
Fish.
Earthworms, insects.
Cereal grains, seeds, grass.
Turnip, potato.
45. Gull, Herring (*Larus argentatus*).
Fish.
Earthworms, slugs, snails.
Potato tubers, turnips.
Cereal grains, seeds, grass.
Clover.
46. Rook (*Corvus frugileus*).
Cereals in spring.
Potatoes later.
Seeds, grass, leaves.
Insects.
Spiders, snails, &c.

METHODS OF APPLYING LIME.

By PROFESSOR JAMES HENDRICK, B.Sc., F.I.C., University of Aberdeen,
and JAMES M. SMITH, Cults, Pittlesie.

IT is not the intention to deal in this paper with the action of lime in the soil or with its uses to the soil and crop, or with the rate at which it wastes in the soil. One of us has already written recently on these subjects for the Society ('Transactions,' 5th series, xxvi., p. 218, 1914). We have been requested by the Publications Committee to give in this paper some account of the various methods by which lime is applied to the soil.

Liming a good old Practice.—In the past fifty years a great change has taken place in the practice of liming, and far less lime is now used than formerly. In many parts of Scotland the use of lime, whether in the burnt or in the mild form, has been practically given up for many years, and in travelling about Scotland an observant person cannot but be struck by the large number of disused limekilns which are to be seen in various parts of the country, many of which were supplying lime for agricultural use till quite recent times. In consequence, many practices which were at one time common and familiar to farmers have been forgotten or almost forgotten. An illustration of this can be seen in the inquiry columns of the agricultural papers, where questions as to the use of lime are of constant occurrence.

Formerly the use of lime was a practice as thoroughly established in agriculture as the use of dung. One cannot read the 'First Statistical Account of Scotland,' written in 1791 to 1798, without being impressed with the important part which the use of burnt lime, marl, and shell-sand played in the agriculture of the period. The value of a good and cheap supply of lime within easy reach of a parish is frequently mentioned. That was a period in which the agriculture of Scotland was being greatly improved, and one of the means largely used by the improvers was to lime the soil. For instance, the minister of Foveran, Aberdeenshire, describing the rapid increase in the use of lime in his parish, to which it had all to be imported, writes (1793): "The demand for lime has increased in an astonishing degree, at least thirty cargoes having been imported this year. It is only about twenty-six years since the first cargo of that valuable species of manure, which was given gratis by one of the heritors to

his tenants, in order to convince them of its advantages, was imported into this parish." The minister of Birse, who deals at length with the use of lime in his parish, writes: "One great advantage this parish enjoys is its abounding with limestone, which is to be found in many places on or near the surface." He waxes a little ironical over some who do not use lime. "The lime they lay upon the grounds has much effect. Some, however, aver that to lime their ground is to no purpose, as, they say, it has no effect because the ground is on limestone. Whether this be a just remark, or only an excuse for indolence, is left to the skilful farmer to decide. Where a sufficient quantity of lime is allowed it cannot fail to secure a crop."

A generation later, a well-known writer on agriculture (J. C. Loudon, 'Encyclopedia of Agriculture,' 2nd ed., 1831) states: "Next to farmyard dung lime is in most general use as a manure, . . . and its effects are much more lasting and in many instances still more beneficial than those of farmyard dung."

Heavy Dressings formerly used.—It was shortly after the introduction of ground lime, a comparatively few years ago, that the practice of liming began to revive. In the old days ground lime was unknown, and burnt lime was generally applied after being slaked. The quantity given in a single dressing in those days was generally large. The Statistical Account mentions quantities from 16 to 50 bolls per acre as being in common use, and even such quantities as 60 and 70 bolls per acre are mentioned. Thus the minister of Premnay (1795) states that one proprietor encouraged his tenants to improve their farms by giving them 50 bolls of lime to each acre, and raised the rents from 15s. to £2 an acre at the same time. The lime "cost him at that time about £5, 5s. In three years the additional rise of rent indemnified him, and yet his farmers paid him their rents regularly; and one of them received £11 from his landlord, or the rent of 5½ acres, for 2 acres of sown grass." Again, the minister of Kinneff writes (1793): "To strong land they give from 40 to 70 bolls of lime shells to the Scotch acre, and to land that is lighter, from 30 to 40 bolls are allowed." Such large dressings were given only at long intervals.

Even so modern an authority as Stephen's 'Book of the Farm,' 4th edition, 1891, states that 100 bushels to 200 bushels of lime per acre is a fair dressing, and that dressings up to 500 bushels per acre are sometimes used. This work also states that about 100 bushels was common for light land and 200 bushels for heavy land. As it further states that lime weighs ¾ to 1 cwt. per bushel, 200 bushels may mean about 10 tons per acre.

The Labour Question.—In those days labour was cheap and

much less fastidious than at present. Nowadays the use of lime has to be regulated to a great extent by the cost of labour, and by the necessity of applying the lime by the least unpleasant and laborious methods. While the great agricultural depression was no doubt the chief cause, the increasing cost of labour and the desire to avoid unpleasant work were among the causes which led to the great diminution in the use of lime during the last thirty years of the nineteenth century. In considering methods of applying lime at the present day, the labour question has always to be kept in mind. Before using lime of any description the farmer would be well advised to carefully consider how he is placed for labour.

While in former days the difficulty of obtaining the necessary labour did not cause the farmer who proposed to use lime so much anxiety as at the present, on the other hand the present-day farmer has at his disposal labour-saving machines and appliances which were not known to his predecessors. The old-time farmer had often to cart his lime long distances, and all the labour of slaking and spreading had to be done by hand. The railway, the traction-engine, grinding machinery, and the manure-distributor now help to get over difficulties which would otherwise be insuperable.

Many Methods of Liming.—There are different methods of applying lime, and different customs in regard to liming in different parts of the country; also in many cases practices which were at one time well known have died out and been forgotten. In these circumstances it seems important to draw attention to practical methods of using lime which are suitable to present-day conditions.

There is no one "best" method of applying lime which can be laid down as the only right one to be used under all conditions. The method must vary with conditions of labour and cropping, with the kind of soil, and with the kind of lime used. Various opinions are held as to the quantity of lime which should be used per acre, the time in the rotation at which it should be applied, and the time of year at which it should be distributed. All these are points on which there is room for a good deal of elasticity. There are, however, one or two matters which are of fundamental importance, and have to be kept in mind in preparing plans as to the application of lime.

Fundamental Considerations.—

(1) Sufficient lime should be applied to counteract any sourness in the soil. In cases where a soil has long been without lime, this may mean that a considerable quantity, such as two or three tons per acre, or even more, may require to be given as a start. In recent times agricultural chemists have

devised means by which the "lime requirement," or need of the soil for lime, can be readily determined.

(2) It may be harmful to apply a very heavy dressing of hot or burnt lime to certain kinds of soil, and especially to light soil, but a very heavy dressing of a lime compost, or of mild lime in the form of ground limestone, chalk, marl, or shell-sand, can be given to such soils without danger, and will be just as effective, weight for weight of lime, in curing the sourness of the soil. It must be borne in mind, however, that burnt lime of good quality contains nearly twice the percentage of lime that is contained in ground limestone and other forms of mild lime, and therefore about 36 cwt. of mild lime must be used to supply a weight of lime equal to that contained in one ton of burnt lime of good quality.

(3) The more finely lime is powdered and the more thoroughly it is mixed with the surface soil the more effective will it be. This applies both to burnt lime and to mild lime. It should be the great object of the farmer to get his lime as thoroughly distributed through the surface soil as possible.

(4) In most cases carbonate of lime or mild lime is as effective as burnt lime if it is equally well distributed through the soil. In order to supply an equal quantity of lime it is necessary to use about 36 cwt. of carbonate of lime in place of each ton of burnt lime, provided each is of good quality. The decision as to which form of lime is to be used largely resolves itself into a question of cost. In estimating cost, not merely the original costs of the different forms of lime should be considered, but also costs of carriage and of application to the soil.

Burnt lime can be obtained in the forms of lime shells and of ground lime. Carbonate of lime can be obtained as ground limestone, waste lime from causticising plant of paper-works and other works, chalk, marl, and shell-sand. Ground lime is dearer than lime shells, but there is less labour and cost in applying it, so that if, as is often the case at the present time, the farmer is somewhat short of labour, there is no question but that he is best to apply ground lime, as, notwithstanding the higher initial cost of this material per ton, the time and labour saved in applying it as compared with shell lime will recoup him for the extra money laid out. Some forms of carbonate of lime can be obtained very cheaply, but if there is much carriage and cartage, that may render the cost greater than that of burnt lime, as it has to be kept in mind that it requires about 36 cwt. of carbonate of lime to equal in effect 1 ton of burnt lime.

Application of Shell Lime.—There are various methods of applying shell lime to the land. A very common method practised in Scotland is to lay the lime down in small heaps

5½ or 6 yards apart each way. If 5½ yards, or 1 pole apart, there will be 160 heaps to an acre; and if each heap contains 28 lb., or two small square-mouth shovelfuls of lime, this will mean 2 tons per acre, which is a very common dressing. When the heaps are 6 yards apart, which is the rule in some districts, there will be 135 heaps to an acre, and each heap will require to be about 35 lb. to give 2 tons per acre. The smallest quantity which can be conveniently spread by this method with a shovel is 1½ to 2 tons per acre. The small heaps should be immediately covered with earth and allowed to lie ten to fourteen days before spreading. The moisture in the earth then slakes the lime gradually and causes it to swell. A good plan, when time permits, is to go over the ground and cover up any fissures in the heaps which have been caused by the swelling. When the lime is well slaked and has thoroughly fallen to powder, the heaps should be evenly distributed by a shovel over the surrounding soil.

Lime is applied by the above method at different points in the rotation according to the conditions and the object to be attained. It may be applied (1) when breaking land out of lea; (2) on the turnip land; (3) on broken or red land for a barley or oats crop previous to sowing out the land with seeds.

In the southern counties of Scotland the lime is sometimes laid down as described above, on the surface of lea before it is broken up for an oat crop. The land is then ploughed with a furrow about 6 inches deep. The deeper ploughing of the stubble land for turnips will bring the lime up again nearer to the surface of the soil. In this way the lime is well mixed with the surface soil during the turnip cultivation. This is also an excellent time to put on lime as a preventive for finger-and-toe, as it is well mixed into the surface during the whole cultivation for the oat and turnip crops, and has plenty of time to act upon and sweeten the soil before the turnips are sown. Another advantage of this method is that the lime can be put on during the slack time immediately before harvest. On the other hand, it has the disadvantage of spoiling the land for grazing for a period after the lime is laid down. It is specially useful when breaking up old grass which has become almost worthless for grazing. In this case no serious loss takes place through the lime preventing the use of the land for stock for a few weeks.

Where the lime is put upon the stubble land for turnips this should be done after all the ploughing of such land is finished. We do not approve of putting it on land intended for turnips before ploughing or cross ploughing, for in that case the lime is buried by the plough. After the lime is spread

over the surface it is sufficiently mixed into the soil by the action of the cultivators. It is not recommended that lime should be given in this way immediately before the turnip crop. It is much better put on a month or two before turnips are sown. Where the main object is to prevent finger-and-toe, it is better to put the lime on the land before it is broken out of lea.

Lime is often applied by this method, not before the turnip crop but before the clean land barley or oat crop. Lime put on the land at this time has a very beneficial effect on the grass seeds which are sown out with this crop, and one reason why this time is often preferred for liming is that the lime is found to have a specially good effect on the clovers. If the grain is to be sown with a drill machine the lime should be put on after the land is ploughed. After the lime has been spread it should be mixed with the soil with the harrows, or, better still, the land may be given a light turn with the cultivator. If no drill machine is available put on the lime before ploughing, and after it is spread cultivate and plough in lightly.

In these times of dear and unsettled labour we approach the question of costs with considerable diffidence. Costs vary greatly in different circumstances, and such costs as we have given below cannot be taken as applying in all cases. The costs given represent what, in the experience of one of us, the work could be done for in central districts of Scotland at the current price of labour when the estimate was made. We recognise, however, that at present the cost of labour is rapidly rising, and by the time these lines are printed the estimates may be out of date. Further, the estimates are based on the supposition that the carting is done on a fairly level road and that a man takes a pair of carts.

Subject to the above reservation, we estimate the cost of this method to be approximately as follows:—

Driving from station to farm (estimated for			
first mile, if further, cheaper per mile),			
laying down on land included			1/9 per ton per mile.
Covering and spreading			1/9 per ton of lime.
			<hr/>
			3/6 per ton of lime.

To this the cost of the lime delivered at the station has to be added. The cost is, of course, greater the longer the cartage from the station, but the cost does not increase in proportion to the mileage.

In some cases the above method of slaking and spreading lime is modified in the following manner. When the heaps are laid down on the field, instead of covering them with earth, a

man follows with a water-cart and pours about a gallon of water on to each heap. Slaking then rapidly takes place, and as soon as it is over the lime is spread with a shovel.

Another modification is to leave the heaps lying uncovered on the field to be slaked by the action of the air and rain. Then when they are slaked they are spread. This latter is a very uncertain and imperfect method. If the weather is dry the lime is not properly slaked, and is consequently apt to be lumpy and therefore is very imperfectly mixed with the soil. Or if continued wet comes, the lime may be over wetted and may become pasty, after which it is impossible to get it spread properly.

In our opinion the method in which the lime is covered with earth and allowed to be gradually slaked by the moist earth is the best and safest.

Lime Compost.—Perhaps the best way of using shell lime, especially on thin light soils, though unfortunately the most expensive, is to apply it as a lime compost. This method appears to have been at one time much better known than at present when few people seem to know anything about it. In this method the lime is mixed with roadside scrapings, rack middens, cleaning of turnip sheds, scourings of ditches or dams, or any accumulation of earth mixed with organic matter. The accumulations of rack, knot-grass, &c., cleaned from fields can be quite properly used for this purpose if the compost is well made with sufficient good fresh lime. The earth is mixed with lime shells in the proportion of 8 to 10 tons of earth to 1 ton of lime shells. If the earth is dirty and contains docken, thistle and nettle roots, knot-grass and other weeds, it is better to use the minimum proportion given above—that is, 8 tons of earth to one of lime—in order to give the lime full opportunity of killing all the impurities. In such a case some recommend that the proportion of lime should be greater, but we do not consider this necessary. In fact, it is in the experience of one of us that when heavy rain fell after the lime had been mixed with rack and earth in the proportion of 1 to 8, the heat generated was so great that the whole heap went on fire, burned and smouldered for a long time. It is very important that the lime should be mixed at once with the earth and not lie and become slaked before it is mixed. This is important, because it is the heat produced by the slaking of the lime which kills the weeds and dirt in the mixture and renders them innocuous. When mixed in a heap with the earth the moisture in the mass of earth and organic matter begins to slake the lime. As is well known, great heat is given out when lime becomes slaked, and this heat is sufficient to kill all living organisms such as weeds, fungi, insects, &c., in the dirty earth.

After the heap has been allowed to lie for 10 to 14 days it should be turned over. It should then be allowed to lie at least a couple of months before it is applied to the land, and it is all the better if it lies twelve months. If time and labour permit a second turning would be beneficial. This compost or compound can be applied at the rate of 10 to 15 tons per acre, either on the surface of lea, or on the clean land for a barley or oat crop with grass seeds, or indeed at any convenient point in the rotation, for it produces good results, and is free from danger no matter to what crop it is applied.

Though it is expensive to apply lime in this way, the method has several advantages which will in most cases more than repay the farmer for the trouble and expense involved. The compost has value not only for the lime it contains but as a general manure. Weeds and organic matter of all kinds contain nitrogen, phosphates, and potash, and when they decay supply useful humus matter to the soil. If the weeds are burnt most of the manurial value is lost, for the nitrogen, the most valuable manurial constituent, and the humus are entirely lost, and only the small amount of phosphate and potash are saved. But when made into a compost with lime, though the weeds are killed, most of the nitrogen and humus are saved and form a valuable addition to the soil. Further, the lime is not only slaked in the heap but largely turned into chalk or carbonate of lime, especially if it lies for a long time, by the carbonic acid gas given off from the organic matter of the heap. This makes its application to even the lightest and thinnest of soils quite safe. On thin poor soils there is sometimes danger of "burning" when 2 tons per acre of shell lime are applied in the ordinary way, especially if the application happens to be made in a dry season. A further advantage of this method on poor thin soils is that it helps to thicken and add body to the soil.

We estimate the cost of this method to be about as follows:—

Driving from station to farm (estimated for the first mile, if further, cheaper per mile)	1/- per ton per mile.
Mixing 1 ton lime and 10 tons earth, and turning once	5/- per ton of lime.
Carting and laying down on land 1 ton lime and 10 tons earth, mixed as compost	6/- per ton of lime.
Spreading compost, 11 tons	1/9 per ton of lime.
Total	13/9

The cost of obtaining 10 tons of suitable earth, weeds, cleanings, road scrapings, &c., is not included, as this will vary greatly with conditions.

It is to be borne in mind that though this method looks expensive, the preparation of the compost is a job which is often done in the slack season immediately before harvest when the farmer has not much else for his staff to do; at other times it is done either during frost or at the break-up of a storm when not much else can be done; so that in this way the cost is really not so great as it looks on paper.

Any crop which is grown, except possibly potatoes, and more especially old grass, will benefit from a dressing of a lime compost such as has been described.

Another method of applying shell lime, which was at one time extensively used and is still carried out by some farmers, is to lay down the whole quantity required in a large heap in the field. It is then covered over with a few inches of earth and allowed to remain for about four weeks till it becomes naturally slaked, when the heap is driven out and distributed over the land. It is usually laid down at the rate of about 2 tons per acre and spread with a shovel. Sometimes, instead of being covered with earth and naturally slaked, water is poured over the lime and it is rapidly slaked to a uniform powdery mass. These methods have the great disadvantage that the lime after being slaked is very dusty and difficult to handle. In former days people were willing to do these unpleasant jobs, but nowadays it is not to be wondered at that men object to handle the freshly slaked and very dusty lime, which is very unpleasant.

Ground Lime.—Lime is now very often used in the form of ground lime, which is shell lime ground to a more or less fine powder. This is the least troublesome form of lime to apply, and no doubt the popularity of ground lime largely arises from the fact that it can be applied in small dressings, and that there is comparatively little trouble and expense in its application.

There is practically only one method of applying it—that is, with a manure distributor. The quantity to be applied per acre depends largely upon the nature, needs, and condition of the soil, but in many cases the dressings given are too small. The soil requires much more lime than it does phosphates or potash or nitrogen—that is, the annual loss of lime from the soil, which has to be made up by liming, is much greater than the annual loss of phosphates, potash, or nitrogen which is made up by the use of corresponding fertilisers. The best evidence goes to show that arable land loses lime equivalent to something like 4 or 5 cwt. of burnt lime of good commercial quality per acre per annum. It is therefore absurd to expect that the condition of the land, so far as lime is concerned, can be maintained by a dressing of 10 cwt. of ground lime applied once in the course of a five or six years' shift. One dressing of 20 to 30 cwt.,

or two of 10 to 15 cwt., is more like the quantity that should be given in a six-year rotation to maintain the condition of the land.

Where land has not been limed for a considerable period a dressing of 1 ton to 30 cwt. of ground lime is not too much, especially where finger-and-toe in turnips is feared. The dressing, too, should be repeated after an interval of two or three years. In such cases dressings of 5 to 10 cwt., which are sometimes given, are of little effect.

As a general rule, 15 cwt. of ground lime is considered a fair dressing, and this quantity can be readily sown by almost all the manure distributors in use in Scotland. In some cases a larger dressing is given by going over the ground again, but when large dressings such as two or three tons of lime per acre are to be given, it will probably be found more economical to use shell lime by one of the methods given above.

The handling and application of ground lime are disagreeable operations even under the best conditions, and call for care and attention both for man and horse.

For the man it would pay to provide a pair of cheap "goggles" to protect the eyes. Such "goggles" can be procured at almost any ironmonger's for about 2s. per pair.

In the case of the horse, an ordinary thin piece of sacking, such as a chaff sheet, should be put right over him, covering the whole upper half of the body from the withers back, and secured either to the shafts of the distributor or to the britchen and draught. Further, it is advisable in sowing ground lime not to sweat the horse, as cases have been known where the horse has been burned and the hair has come off a large portion of the body owing to the lime sticking to the wet hair. The horse should be wiped down and brushed at once after liming, and it is recommended that the man should wear a cloth over the mouth and nose while distributing lime.

It is also advisable where the gradient of the field will permit to sow the lime across the prevailing wind, if any, and the man should drive the horse from either "near" or "off" side, or even lead him, so as to keep out of the dust.

The user of ground lime would be well advised to drive it, where practicable, straight from the station to the field and sow it at once. If laid down in, say, a cart-shed for a week or so, on coming to lift it many of the bags will be found to be burst, and this will entail the filling of it into fresh sacks.

Many farmers start one pair, or whatever force may be necessary—depending upon the distance from the station—to drive the lime to the field, and start the distributor at the same time. They are thus practically able to sow the lime within an hour or two of it being laid down. The advantage

of this is that if wet comes on one does not have a good many tons sitting in the field at the mercy of the weather.

We estimate the cost of putting on ground lime about as follows:—

Driving from station and setting down in field									
(estimated for first mile, if further, cheaper									
per mile)	:	:	:	:	:	:	:	:	1/- per ton per mile.
Cost of sowing	:	:	:	:	:	:	:	:	1/8 per ton of lime.
									<hr/>
									2/8 per ton of lime.

Carbonate of Lime, or Mild Lime.—As already stated, carbonate of lime, or mild lime, can be used for liming the soil where it can be obtained in a finely pulverised condition, and, if an equal weight of lime is applied, it is in most cases as effective as burnt lime. Carbonate of lime can be used in the forms of ground limestone, chalk, marl, shell-sand, and waste lime from works. Ground limestone has been introduced for agricultural use only during comparatively recent years, and in some quarters it has been hailed as a new agricultural discovery. In reality the use of carbonate of lime in agriculture is one of the most ancient of practices. What is new is the use of machinery for grinding hard limestones to powder.

In former times farmers were able to use carbonate of lime only when they could obtain it already powdered, as in shell-sand or marl, or when it was in such a soft and porous form—chalk, for instance—that it could be easily pulverised by the agency of frost or by the use of crude implements. Before they could use a hard limestone it had to be burned and slaked, for only by these means could it be reduced to a fine powder fit for distribution on the soil.

Shell-sand and Marl.—At the present day shell-sand is used for dressing the soil in the Orkney Islands and in parts of the Hebrides, where it can readily be obtained in quantity; but the use of such materials as shell-sand and marl has to a large extent died out throughout the rest of Scotland. Where these substances can be obtained cheaply their use might usefully be revived.

Old records, such as the 'First Statistical Account of Scotland' already referred to, show that marls and shell-sands were formerly extensively used, and were held in high estimation as a means of improving the soil. Thus we are told (1793) that at Fraserburgh there was an "inexhaustible shore of very fine shell-sand," which was found very profitable in raising crops. A similar statement is made for the parish of Rathen. In Slains a great deal of marl of different kinds was found, "some of which is very rich and produces excellent crops." Also in the same parish there was found

calcareous sand, of which it is said: "This sand is quite small, and has a very great proportion of sea-shells ground to powder among it. There is plenty of it on many farms, where it produces most excellent crops, and continues for many years."

The use of marl of various kinds, shell marl, clay marl, and stone marl, is mentioned again and again in Ross-shire, and generally a most favourable account of its value for manure is given. Thus of the parish of Rosskeen it is stated that there is "a most extensive and rich bed of shell marl of about 70 acres extent, which lies in the middle of the lower district on the property of Munro of Cubrain. . . . Its fertilising quality has been amply proved on the farm of Milncraig." In the account of the parish of Tarbet various beds of marl and shells are mentioned, and among other statements the following may be of interest. The marl "found at a place called Meikle Tarrel is of the richest quality, and has been used for some years past by the farmer there, much to his advantage."

Many similar statements, of which the above are merely a few examples, are found throughout this great work, and show that over one hundred years ago shell-sand and marl were known and used far more widely than at the present day. Whether these substances can again be used will be largely a question of the cost at which they can be obtained. It would be to the advantage of proprietors on whose estates they are found to encourage their use among their tenants, as appears to have been done by many proprietors of a former day.

Ground limestone is not manufactured at present, so far as we are aware, to any great extent in Scotland, but is obtainable in Fifeshire and Banffshire, and possibly in other districts. If the full value is to be obtained from the limestone, it should be really finely ground so that it can be thoroughly mixed with the soil. It should, for instance, be ground to a fineness similar to that of basic slag or ground mineral phosphate. If it cannot be obtained really finely ground, and at such a price that it is not much dearer per unit of lime than shell lime when delivered on the farm, farmers will be well advised to use ground or shell lime in preference to it. Ground limestone can be applied direct to the soil, and no cost for labour is incurred in slaking or preparing it for application as is the case with shell lime. It may therefore, like ground lime, cost a little more per unit of lime than shell lime and still be equally cheap to the farmer.

The use and value of the waste lime of paper-works, and of other works which produce precipitated carbonate of lime as a by-product, have already been dealt with by one of us in the paper in the 'Transactions' for 1914, to which reference has

already been made. Where such substances can be obtained cheaply they are well worth consideration.

The application of these different forms of carbonate of lime involves no special difficulty. There is no danger of the mild lime burning men or horses. The handling of it is not in any way dangerous to health. It can be applied in any reasonable quantity, even to light land, without producing injury to crops. It can be applied at any convenient time of year and to any crop. It can be stored for any length of time without deterioration and without bursting bags in which it may be contained. Farmers can therefore cart and apply it at such times as other work is slack and labour is available.

It can be laid down in heaps of convenient size on the field and spread with a shovel when large dressings are given, or it may be spread directly from the carts, as has been done in certain cases known to one of us. If the dressings given are not so large it can be spread by means of an ordinary manure distributor. If frequent dressings are given in this way, sufficiently large amounts of it to bring sour soils into condition may thus be applied. It is, however, probably most economical to apply dressings of not less than 2 tons per acre at a time, in which case it can be best distributed by a shovel. No doubt if the use of such substances became sufficiently great to create a demand for it, agricultural engineers and implement makers would have little difficulty in producing a machine able to distribute powered carbonate of lime at the rate of 2 tons per acre, or any other rate which might be desired.

IMPROVEMENT OF MOORLANDS

FOR GROUSE AND SHEEP.

By SIR HUGH SHAW STEWART, of Greenock and Blackhall, Bart.

THERE are still some proprietors under the impression that sheep-grazing must of necessity be detrimental to the sporting value of a moor. Others, while willing to concede that there may be compensating advantages—besides the twofold rent—are by no means clear as to how far the supposed advantage of grazing sheep on grouse moors can be substantiated. This paper is written with the object of affording some ascertained facts on which to found certain conclusions proving that the treatment of a moor with a view to enhance the value of the sheep stock cannot fail also to improve and increase the stock of grouse. And further, that steps taken to improve a moor for sporting purposes may also redound to the profit of the flockmaster.

I am in a position to produce particulars proving both propositions, as I happen to hold “in hand” a sheep-stock grazing, consisting of the greater portion of a moor, the shooting over the whole of which I have retained for successive seasons.

The subject is the Duchal Moor, in the parish of Kilmacollm, Renfrewshire. It lies between the 600 and 1200 contour lines of the ordnance survey, and has an annual average rainfall of about 70 inches. The extent of the portion grazed “in hand” amounts to 4000 acres, but the area shot over comprises about 1500 additional acres grazed by tenants, and amounts to 5500 acres in all.¹

SURFACE DRAINAGE.

About forty years ago the moor was drained, but little had been done in succeeding years to maintain the drains until 1904, when, having inherited the moor, I decided to expend £50 each summer on the gradual renewal of the drains. It took ten years to go over them all, at a cost of £564. In the following years, 1914 and 1915, a further sum of about £100 was expended in going over the drains first dealt with, so that the total cost to date has been nearly £700.

The immediate cause for taking the drains in hand in 1904 was the flooding of the best grazing area, owing to the drains in the steeper parts having gradually scoured until the sediment

¹ This does not include the Creuch hill, which is let.

had accumulated on the flatter ground. Here the drains had become closed up with moss, &c., so that in wet weather the flooded area was useless for grazing, and, when the moisture subsided, it became unhealthy for stock.

In the course of the draining operations it was found that in the old days, when the moor was a common grazing and the small tenants had a right to cut peats for fuel, the lower parts of the moor, next to where the people formerly lived, had become studded with holes where the peat had been cut and the holes left. In some parts of Scotland where this right existed and the peat-cutting was properly supervised, two or three of the tenants were often appointed to see that such holes were properly drained and the surface sods replaced so that a level surface was secured. On the Duchal moor this practice cannot have been enforced, for the holes—two to four feet deep—had been left open. Moss and green grasses growing round these holes had lured the animals to their doom, for it was no unusual thing to find skeletons of four to eight sheep in each hole. The value of these sheep would have paid for the draining and filling up of these holes many times over! In the operations under review, when a section was being worked where these holes occurred, it was arranged that the drainers noted the places, and, after the contract was finished, returned, drained and filled up the holes with the displaced sods, and by this means the ground was gradually made safe.

It should be mentioned that the drains were cut from 20 to 24 inches in width at the surface, tapering to 3 to 5 inches at the bottom, the depth depending on the thickness of the surface over the subsoil, and the slope of the ground.

HEATHER-BURNING.

Previously to 1906 there had been no regular system of burning the heather, and, in some directions, it was possible to walk for two miles in heather up to the knees. In 1906, under a change of gamekeepers, aided by two or three succeeding seasons of unusually dry character, large areas of old, useless heather were burned away. In places where the heather was not extremely old the young shoots appeared in two years' time, but where the heather had been excessively old and had partly died away from age it took four or five years for the young shoots to cover the ground.

RESULTS ON SHEEP STOCK.

The following tables speak for themselves. Local market prices for lambs, courteously supplied by Messrs Wilson &

Laird, auctioneers, are adduced for comparison. The sheep were sold at Lanark and Ayr.

	Sheep sold off the moor.		Duchal lambs sold at Paisley	Average market prices at Paisley for all b. f. lambs sold.
1910	543 sheep at 14s.	.	—	—
1911	548 " 15s. 6½d.	.	—	—
1912	605 " 16s. 2½d.	.	20s. 4d.	16s. 3d.
1913	583 " 19s. 6½d.	.	25s. 9½d.	18s. 1d.
1914	742 " 20s. 1½d.	.	26s. 3d.	18s. 3d.
1915	757 " 22s. 6½d.	.	28s. 4½d.	19s. 8d.

In these tables attention may be called to—

(1) The gradual increase in the number of sheep sold. This increase has occurred without any alteration in the number of ewe lambs kept for stock purposes, or in the drawing out of "cast" ewes. It can only be attributed to a decreased death-rate, and an increase in the health and vitality of the flock.

(2) The increased prices. These are maintained even when compared with the recent increase in market rates.

As to the value of the wool, I quote the following from the overseer's report: "In 1906 the average weight of wool per head was within a small fraction of 4½ lb., and in 1913 it only wanted the same fraction of being 5½ lb., or an increase of 1 lb. per head. Before 1906 it was a rare thing to see a rough belly when clipping, and the points of the wool along both sides of the sheep looked as if it had got a hard dressing with a rough brush or comb. Now, the clippers will tell you, it is a more tedious job than it used to be, as the whole sheep is to clip." Apart from the value of wool lost by wastage from long heather, it does not need an expert to realise how much the general health of the sheep must suffer from the want of underbody wool, and the increase in numbers as shown above must be to some extent attributed to the better heather conditions.

While it is impossible to define precisely how much of the improvement in the sheep stock has been due to attention to drainage, and how much to systematic burning of the heather, it is obvious that the improvement in the wool was directly due to the burning away of the hard, straggling branches of heather.¹

STOCK OF GROUSE.

Now as to the improvement in the *stock of grouse*. It is not necessary to labour the argument that, in a rainy district, adequate drainage, which increases and improves the quality of the grass, must also benefit the growth of heather. But I would like to point out that surface-drainage alone does

¹ The staff available for heather-burning on this moor consists of three keepers and two shepherds, with the occasional assistance of estate workers.

little to improve the feeding for grouse unless it is accompanied by systematic heather-burning. If the heather is allowed to continue to grow unchecked and unrenewed, a moor becomes covered with the long, hard, straggling switches of heather which, as we have seen, do so much damage to the sheep's wool. This kind of heather is of little use to grouse, except for shelter, as it does not afford nearly the same amount of bloom and subsequent seed (on which the adult grouse mainly depend for their winter food) as is afforded by younger and more vigorous heather plants. Moreover, a vast amount of old heather is distinctly detrimental to young grouse, who feed for the first fortnight or so on flies and insects, for these are not to be found under the screen of dense heather.

In this connection reference may be made to the evidence recorded from a famous moor in the South of Scotland, and to which attention has recently been drawn by Mr W. Barber, who acted as Secretary to the Board of Agriculture inquiry into Food Production.¹ It appears that this moor was formerly, for sporting purposes, kept free from sheep. More recently sheep were admitted, and it has been found that the sheep-walks have proved of great advantage to young grouse. Not only are the latter better enabled to get about through the heather, but they have more opportunities for access to flies and insects congregating on the sheep droppings scattered along the walks.

In order to show the combined results of proper draining and heather-burning on the Duchal moor, I append the following extract from the game-book:—

	Grouse killed.
1909 (in hand)	844
1910 "	1448
1911 "	1899
1912 "	1940
1913 "	1696
1914 (let)	1739
1915 (keepers only)	2135

In each of these seasons the same shooting policy has been pursued—viz., to kill as many grouse as was compatible with leaving a sufficient stock to breed. It is only fair to mention that some of the marked improvement was due to the killing down of vermin, following a change of keepers in 1906, but after making due allowances, I have no hesitation in saying, from an intimate acquaintance with the moor in its sporting aspect for over forty years, that it has been mainly by seizing

¹ See the Board of Agriculture Departmental Committee Report, pp. 244, 245 (evidence of Mr J. H. Milne-Home).

every opportunity for burning tracts of old heather that the annual average "bag" has been raised from less than 600 brace to 1200 brace; or, in other words, that the normal average "bag" has been doubled within a period of ten years.

SUMMARY.

I am not going to contend that the interests of sheep and grouse do not sometimes conflict. The proprietor, or more often the shooting tenant, may occasionally be annoyed to find that dates fixed for shooting clash with the autumn sheep gatherings. On the other hand, the sheep farmer and his shepherds cannot be expected to view with unmixed delight the spectacle of bands of sheep scurrying before a long line of men and boys, waving flags, advancing over the skyline.

"Live and let live" is a good motto to remember when interests are opposed, and the practice of "giff-gaff" smooths the way to many a mutual end. By an exchange of views early in the season suitable dates can be arranged. And if the gamekeeper knows his business—if he does not, he should be dismissed—he will lose no opportunities for arriving at a good understanding with the shepherd, so that he may secure the latter's skilled assistance at the heather-burning. The shepherd also, for the benefit of his sheep, will be ready to respond to the keeper's invitation to take part in lighting the heather and controlling the fires.

Here let me sound two warning notes:—

(1) Shepherds and farmers who deliberately set fire to the heather, without any care to prevent extension of the flames, are behaving very foolishly. Fires allowed to spread unchecked may easily do great damage to fences, plantations, &c., and, in any case, the proceeding is bound to create distrust and antagonism in the minds of gamekeepers and their employers, especially if these are endeavouring to burn the moors on a rational and continuous system.

(2) It is worse than useless to try to burn heather if it is not dry to the roots, for if any life is left in the stem of the plant it will seek to sprout from the old stem and not from the roots, and consequently real renewal does not take place. In wet situations there must be many seasons when the heather is not dry enough to burn properly. In such cases the obvious remedy is to wait for a dry spring and then burn in extra quantities.

Having given details of improvements undertaken with the object of benefiting both sheep and grouse, I may refer to some minor changes on the same moor, planned solely (as I supposed) in the interests of sport, which are found to have reacted to the

advantage of the sheep. In order to reach the more remote parts of the moor with the least expenditure of time, I caused tracks for pannier ponies to be made in order to circumvent some very uncompromising tracts of deep peat-hags. Not only was the sporting object attained, but the shepherds have found that these same paths are of great assistance to the sheep in the time of snow, and to the shepherds themselves at all seasons, as they are thereby enabled to reach more quickly the difficult and least accessible places. Again, I found it desirable to erect a number of additional grouse-butts¹ to suit different winds, and, as I hold that the more butts there are the less do grouse associate them with danger, I was not sparing with their numbers. The shepherds assure me that the sheep resort very freely to these butts for shelter in stormy weather.

To prevent misunderstanding, let me conclude with an important reservation. I have no desire to encourage indiscriminate heather-burning. The facts detailed above relate to a moor where the peat is deep, and on which the heather quickly renews itself after burning. There are many soils and localities where the heather would take such a number of years to recover from too extensive burning that the subsequent dearth of heather would result in a serious food loss to sheep as well as to grouse, to say nothing of the disappearance of the sporting value.

It is on extensive moors of a deep peaty nature that heather-burning is attended with the best results, and if, in the present national crisis, when one of the vital needs of the time is to increase our home supplies, I have said anything that will encourage proprietors and factors to take steps whereby the supplies of home-grown mutton and wool may be increased in volume and value, without consequent diminution of sporting values, this paper will not have been written and published in vain.

¹ The climate is too wet for sunken pits.

CATTLE REARING.

By WILLIAM BRUCE B.Sc., Edinburgh.

It does not fall within the scope of this paper to show how cattle rearing, which at one time occupied a very prominent part in Scottish Agriculture, was abandoned and cattle feeding put in its place by the majority of arable land farmers. During the latter half of the nineteenth century various factors, some social, some economic, and some political, so affected agriculture and rural life as to leave farmers little choice in the matter—at least for a time. Such wholesale changes, however, are liable to upset the economic balance, and frequently call for some form of reversion to the old order of things. The writer, being convinced that we were in danger of losing to some extent our knowledge of the art of cattle rearing, instead of modifying it to suit the times, has for many years sought to keep in touch with the few who continued to rear cattle and appeared to do it with most success, believing that the time would come when this information would be of service. That time now appears to have arrived. Good young cattle of all kinds have been abnormally scarce and dear for a number of years. Moreover, the progress of farming has opened up new possibilities in the direction of early maturity that cannot be pursued to the best advantage without a supply of the best class of home-bred and home-reared stock.

The scope of this article will be confined to what is commonly known as “commercial” cattle. That at least will exclude the rearing of valuable pedigree beef cattle, which are raised by what may be regarded as the natural system of rearing, in which the dam nurses her own offspring. This plan is generally regarded as too expensive for raising ordinary stock. Nevertheless there are in various parts of Scotland modifications of it, some of them highly intensive, in actual practice, that are worth special consideration, because they demonstrate that the elasticity of this method permits of its being modified to fit a wide variety of circumstances. Opposed to the natural system of rearing and its modifications, we have the artificial system in its numerous forms, which vary from the liberal use of whole milk during the early part of the calf's life, to its almost total replacement by various substitutes. The distinguishing characteristic of what may be called the artificial system is that in all cases the cows are milked and the calves are fed by hand.

I. THE NATURAL SYSTEM.

The circumstances of this country have evolved at least three modifications of the natural system of rearing calves, and these we shall discuss.

Rearing in Sheltered Fields without Housing.

The simple and most natural method of rearing, which consists of allowing the dam to produce and rear her own offspring, although in many respects unrivalled for producing a first-class calf, is too expensive, as a rule, for the production of ordinary cattle. There are, however, special circumstances in which it has strong claims for consideration even on economic grounds. Where little or no housing is available, but there are sheltered fields of second- or third-rate grass, such as are frequently to be found in the vicinity of the residences of extensive landowners, a form of this method is frequently practised with success. The cows remain in the fields all winter and live on what they gather, supplemented by a little second-rate hay or a few turnips thrown out on the grass, and sometimes a little concentrated food in spring. The supplementary keep actually necessary is determined by the amount of foggage or rough grass available and the severity of the weather. These two factors set very definite limits on the locus of this form of rearing. It need not be attempted in high districts, and particularly those subject to heavy falls of snow and prolonged spells of severe weather. Neither is it suitable for fields that are naturally grazed very close. In both cases the cost of extra keep would cut deeply into the somewhat limited returns. Besides, scarcity of winter keep tends to bring the cows to the calving in poor condition, which is a source of risk and additional expense. In this method of rearing, the cows must be carried over cheaply and in good natural condition from weaning time in autumn to calving in spring, and as they remain out during winter they must be hardy and good foragers. Cows and heifers of the Galloway and the West Highland breeds have been found to answer this purpose well. Besides, they also make handsome park cattle. Along with hardiness and good looks they possess good beef form. Their only inherent defect for producing modern commercial cattle is slowness in coming to the block. Experience, however, has shown that this drawback can be almost entirely eliminated from the offspring by mating the cows with well-bred, early maturing, Shorthorn bulls of the best beef type. A good illustration of the merits of this cross is to be found in the

better class of south-country blue-grey, which is usually produced by mating a Galloway cow with a pure-bred white Shorthorn bull. By this means an animal is produced that is much appreciated as a butchers' beast. Nevertheless, many experienced cattle feeders prefer not to have them till they are over two years old, because if young they are slow to start. In this respect they should not be confounded with the north-country blue-grey, which is a common product of the Aberdeen-Angus on the one side and the Shorthorn on the other. Both make equally good butchers' beasts; but the latter, in the hands of good feeders, can easily be made ripe for the butcher at from twenty to twenty-four months.

The Shorthorn is the only sire that appears to have gained approval from experience in breeding commercial cattle from these hardy out-wintered cows. Shorthorn bulls also breed exceedingly well with Highland cows. This has been carried out on a large scale, with very good results, by the Earl of Camperdown in his policy parks at Camperdown House; and I am specially indebted to his Lordship and his factor, Mr Joseph Murray, for every facility during the last fifteen or sixteen years for watching this and other methods of breeding commercial cattle which have been practised on a somewhat extensive scale at Camperdown for about twenty years.

The Camperdown breeding with Highland cows has brought out several interesting points. The first cross partakes very largely of the character of the Shorthorn, and this is intensified in later generations. In the third, the only marked difference is a greater strength of horn than one would expect to find on well-bred Shorthorn cattle. Another point demonstrated, and one of economic importance, is that the first cross, and even later ones, inherit the hardihood of their dams to such an extent that they make good "outliers," and when put to a Shorthorn bull they are an improvement on their dams for breeding good, early-maturing, commercial cattle.

It has been pointed out that the peculiar merit of this method of rearing is that it can be carried on without housing. In actual practice, however, it is found to be a great advantage, if not an essential, to have some cheap accommodation, such as a wooden shed with stalls, where the cows can be taken in and tied up for a week or two at calving time. By this means they can be given better attention, and both the cows and their progeny become accustomed to man, and are much easier to handle when this becomes necessary, and of course the risks are reduced. The best calving time for this class of stock appears to be early in April, and the calves should be weaned and housed at night and put on to extra feeding by the beginning of October. To leave them out later

runs the risk of losing calf flesh, and also of reducing the summer condition of the cows, with the result that they are much more difficult to winter. Cattle kept in this natural way breed exceptionally well. The returns amount to nearly one calf per cow per annum. Death and disease are at a minimum. Depreciation of stock is practically non-existent, for heifers bought in for this purpose, under three years old, will continue to breed regularly for six and seven years, and then bring their in-buying cost from the butcher. The cost of rearing cattle by this method varies chiefly with the value of grazing. At Camperdown it was found, with grass worth about 20s. per acre, that the cost of grazing cow and calf amounted to about 35s. per annum.

Rearing with Housing.

Suitable winter accommodation greatly widens the scope of cattle rearing. It opens the way for breeding from cows of the best beef breeds, such as Shorthorn and Aberdeen-Angus, or should the conditions demand that intensity be the aim, deep milking cows may be kept. Given adequate housing, then it is the food supply that is the chief factor in determining the character of the cattle rearing that may be followed with advantage. The food supply in turn depends on quality of land—on climate, including altitude, crops grown, and the kind of farming pursued. These factors are found to be responsible for considerable differentiation in the various modes found in practice. In some districts the circumstances demand that breeding and fattening be separated. But as a rule the tendency is to combine both, and also to push on continuously in the direction of early maturity where the circumstances permit of this course. In bringing out really good cattle, it should make little difference in principle whether these two parts are separated or not; and as an illustration of the complete process, probably nothing better could be given than the indoor breeding that is practised on a considerable scale at Camperdown Home Farm, where the work in this line, which has been going on continuously for over twenty years, has been crowned with remarkable success in turning out the choicest type of butchers' cattle.

The breeding at Camperdown is all the more interesting at this time, because much of the land used for this purpose is on a farm which would be regarded by many as too good and too highly rented for rearing cattle. The Home Farm includes the farm of Dryburgh, which extends to about 330 acres, and being situated sufficiently near to Dundee to give the option of suburban farming, it is rented at nearly

£2 per acre; and a considerable area of second-rate land which is mostly in grass, and which, although fairly high lying, is reckoned, owing to its proximity to Dundee, to be worth about 25s. per acre. The former is intensely farmed in a rotation consisting of potatoes, wheat, turnips, barley, grass (hay), and oats. The grazing, with the exception of the aftermath, is confined to the poorer land, which is laid down with a seeding of grasses and clovers to some extent after Elliot's system, for from six to ten years. Every year part of the worst of this grass is taken up and put through a course of cropping consisting of oats, potatoes, turnips, and oats, all of which are very liberally treated with phosphatic and potassic manures along with a moderate dressing of lime. This treatment produces good crops without dung, and is an excellent preparation for the grass.

The breeding stock at Camperdown, altogether, including the "outliers" already referred to, extends to about seventy breeding cows, and the progeny of these are all fattened at the Home Farm. The indoor breeding is carried on with about thirty-five good Aberdeen-Angus cows, a large proportion of which are practically pure bred. They have all been reared together, and this, along with careful selection, no doubt accounts for the remarkable harmony which prevails in the somewhat densely filled cattle courts where they and their calves are all housed together. These cows are bred mostly to Aberdeen-Angus bulls, which are carefully selected for breeding butchers' cattle. It is a cardinal principle in the management of this section of the herd that the calving of the cows should take place in February; but the heifers, as a rule, are not allowed to bring their first calf earlier than April, when they are well over two years old, because it is found that early calving is hard on them, and they are apt to get too much reduced in condition if they have long to nurse before the grass is ready. Calving usually takes place in stalls, where those near parturition are tied up for the time being. As soon as this is well over the mother and her offspring join their fellows in the court, where a large number of cows and calves run together.

The feeding of the breeding stock is carried on as cheaply as possible. The cows get nothing but a good allowance of turnips twice a day, and as much oat straw as they can eat, until they go to grass in May. The calves, in addition to their mother's milk, have "creeping" access to a fenced-off part of the court where they can help themselves to cut turnips and hay as soon as they are inclined to do so. The cows are generally put on to the oldest grass at the beginning of the season, and later they may clean up

the younger fields after the yearlings, which always get the best of the grass before being housed to fatten off in the autumn and early winter. The calves are weaned in the first week of October. It is considered inadvisable to reduce the cows by allowing them to suckle later, and the calves at this season make better progress if put on winter keep. They are put in courts where they get turnips and straw twice a day, along with 1 lb. of good compound cake and 1 lb. dried grains, the former being given first thing in the morning and the latter in the afternoon. After mid-winter the concentrated food is gradually increased to 3 lb. per head per day. Last season a number of these calves were weighed, both in the autumn and the spring. At the middle of November, without being fasted, the heaviest were between 6 and 7 cwt., and the lightest between 4 and 5 cwt. On 9th April 1915 a selection of the best were just over 8 cwt.

At the commencement of the grazing season the stirks are put on second year's grass, and they are allowed 3 lb. cake per head per day. About the end of July they are put to graze the aftermath that follows the hay taken from the first year's grass, and by this time the allowance of cake has gone up to from 5 to 6 lb., which is now dealt out twice daily. As soon as these cattle have got the best of the aftermath they are brought into the courts and finished off as quickly as possible on turnips, straw, hay, and concentrated food. The concentrated food, the allowance of which goes up to 8 lb. towards the finish of the fattening period, consists of equal parts of hashed grain, or some similar material such as dried grains, and compound cake. In order to make room for the cows it is essential that most of these cattle be got away to the butcher between November and the middle of January; and the weights reached vary from 10 to 13 cwt., the average being about 11 to 11½ cwt. The age of the bullocks when they go to the butcher is about 22 months, and that of the heifers about 21 months. The former as a rule grow a little more rapidly, but the latter mature rather earlier. The cattle are sold in Dundee and Perth auction marts, where competition for them is keen at the top price of these markets.

To complete this illustration we require to return to the cows. When the calves are weaned and housed in October the cows are put on a bare grass-field until the milk, which is drawn three or four times to relieve the tension on the udder, goes off, and they lie out till near the end of November. They are then taken into a shed overnight and given a feed of oat straw. By the middle of December the grazing is considered finished, and the cows are now housed in the cattle courts which by that time are being vacated by the fattening cattle. With the

exception of an occasional "airing" on a good day, the cows now remain indoors and pass the winter on nothing but turnips and oat straw. As already mentioned, the cows, when approaching parturition, are tied up in a stall until this event is safely over; but it is not uncommon for a cow to calve in the court, where the cows live in great harmony.

Intensive Rearing.

While the illustration which has just been given represents in many respects what can be done either wholly or in part on second- and third-rate arable land, still one calf per cow per annum does not satisfy all cattle rearers; and, indeed, where calves are reared on good land it is often desirable to follow a more intensive method. In many cases two calves are put on for the season instead of one. This presents no great difficulty beyond the application of a little skill and care. When the cow calves she should not be allowed to know her own from the other calf or calves which she may be given to nurse, otherwise she will favour her own offspring, and then at the best the double rearing is likely to be only a partial success. It is also essential that the cows be moderately good milkers, for unless a cow can give 3 gallons or more per day on ordinary keep for at least 4 or 5 months after calving she is not likely to nurse two calves well. A third point is that better grass is required all through the season than will suffice where only one calf per cow is reared.

Suckling two calves per cow is a method of rearing that is suitable particularly for moderately good land, but it should be pursued with the use of little or no expensive food. The only time one is justified in going beyond turnips and fodder is between calving time and the arrival of the grass, and it will pay to watch the cows during this period, and to assist them with food as may appear necessary. Special care is also required at the end of the season. The calves may require to be weaned, and given concentrated food earlier than when one calf only is put to each cow, otherwise both cow and calves fall away in condition, with the result that the cow becomes too much reduced to be cheaply wintered, and the calves suffer a check which undoes the advantage gained by suckling. In rearing according to this method, the calves should be born sufficiently early to be ready to graze when turned out with their mothers. But on account of the expense of house-feeding the cows, it will not, as a rule, be advisable to have them calving much earlier than March.

In the methods discussed so far, the ordinary cattle foods of the farm, such as turnips and straw in winter and grass in

summer, have sufficed, with little or no concentrated food for the cows, and also for the calves until weaned. On good land, however, something more intensive is desirable. With the aid of concentrated food for both cows and calves the possibilities of calf rearing by suckling may be extended, until it reaches a point on the border-line between the natural and the artificial system, where it may become preferable to adopt the latter altogether. As an illustration of highly intensive rearing, the method practised for something like a quarter of a century on good second-rate land by the late Mr George Prentice, at Strathore, Thornton, Fifeshire, who reared in the way described from sixty to seventy calves annually, is worth recording. His plan consisted in rearing four calves on each cow and two on each heifer. Calving took place in February and March in byres. As calving time approached the cows were tied up, and immediately after parturition the calf was removed, rubbed dry, and associated with a bought-in young calf. Both were then brought in and put on to the cow under the supervision of the stockman. After being fed in this way, the calves were tied up to the wall in the passage behind the cow and let loose to suckle three or four times daily. This was continued for a fortnight or so until the cow had taken properly to her charge. She and the calves were then turned out into a shed along with a few others similarly circumstanced, and ultimately all went to grass together. Heifers were treated in the same way as cows, with this difference, that they got only one calf at a time. The cows were allowed such concentrated food as appeared necessary until they went on to the grass. Towards the end of June or about the beginning of July the calves were taught to eat linseed-cake and bruised oats, and then they were completely separated from the cows and put upon a piece of good grass, usually aftermath, situated well out of hearing of the cow. They remained at grass and continued to get a pound or more of concentrated feeding-stuff until they were housed in autumn.

The first two calves having been weaned, the cow was again tied up in a byre and other two young calves put on to her, much in the same way as the first pair. In due time they went to grass together, where they remained until the calves were weaned in the back-end of the year. Prior to being weaned they were taught to eat concentrated food.

The calves were wintered on turnips, meadow hay, and fodder, along with 2 to 3 lb. of a mixture of concentrated food. Mr Prentice had a high appreciation of hay for wintering these calves.

In this system of rearing it is most important that the cows

be deep milkers. Mr Prentice began his breeding in 1888 with a few imported Dutch heifers, and continued to use this milking blood in his cows right on to the time of his death; and, although he sometimes used as sires Shorthorn bulls and at other times Aberdeen-Angus, after about twenty-five years of this inter-breeding the progeny still showed external traces of the Dutch blood, and the cows continued to inherit good milking capacity.

This method of breeding and rearing demands a maximum of personal supervision. Sometimes a cow proved refractory. The remedy for this is to get rid as soon as possible of those which refuse to conform to the system. These deep-milking, much-handled cows usually make good dairy cows, and a considerable proportion of them can ultimately find a good market for this purpose.

Before concluding this account of various types of the natural system of rearing, there is still another sufficiently distinct from all others to be worth our notice. It differs from the rest inasmuch as the cows and calves are separated except during the time the calves are actually being suckled. It is the most intensive form of natural rearing. The writer has seen as many as five calves regularly reared on each cow by it. Of course well-handled deep-milking cows and good grass are essential, and it should be attempted only on good land and under good climatic conditions.

A good illustration of this intensive rearing is provided by the practice of Mr James Wyllie, Pathhead, Cockburnspath, who for many years reared five calves on each cow, with such success that one had only to see them to be convinced of the possibilities of the method. In practice Mr Wyllie's plan was to turn over each cow as she calved to the wife of one of his shepherds, who was provided with a shed and paddock for the calves, and a piece of good old grass close by as a grazing for the cows. The cows grazed together, and were brought in and tied up in a byre adjoining the paddock three times daily, and each made to suckle a pair of calves. This having been carried through under supervision, the cows were immediately turned out again to their grazing, and the calves were taught to eat linseed-cake as soon as they were old enough to do so. After being suckled for three months the calves were weaned and a fresh pair put on. In this way two, and then two, and lastly one calf were reared on one cow during her lactation period. The shepherd's wife was remunerated on results—so much for each weaned calf. She frequently had five cows in the season. This appears to be not only a good plan of rearing calves, but also of providing convenient work for women anxious to work but who cannot leave home to undertake it.

Another instance of the successful practice of this method is provided by Mr M. Park of Hoprig, East Lothian, who at present is rearing calves by this method. The only modification in Mr Park's practice is that his calves are kept during summer in his large cattle courts, which otherwise at this season would be empty. The cows are brought into an adjoining byre three times a day and the calves let in to suckle.

II. THE ARTIFICIAL SYSTEM.

In this system of rearing the calf's food is given entirely by hand; and while the food may differ little from what the suckled calf takes for itself, as when calves are reared on whole milk, the system presents opportunity for skill in introducing great variety both in food and feeding. In fact, it may be said that the great variety of feeding-stuffs, and particularly modern knowledge and experience in blending them to meet the requirements of young animals, has opened up greatly increased possibilities in artificial calf rearing. On the other hand, hand-feeding opens the door for many accidents such as arise from irregularity and carelessness on the part of the attendant, as well as from lack of "stockman's eye," which is generally keen to observe the first symptoms of trouble. Indeed in hand-rearing so much depends on these things that it has been said that care and regularity in feeding, along with proper preparation of the food, is of far greater importance than fine discrimination between foods that are more or less suitable. As a matter of fact, if the food is properly prepared, and administered skilfully and with regularity, there is considerable choice of material as a source of nutriment required for making a calf meal. In making a selection the more important considerations are digestibility and the production of a blend of nutriment with the proper balance between the nitrogenous and non-nitrogenous nutrients. As regards the former, feeding-stuffs containing a low proportion of fibre should be preferred, because fibrous foods are generally more difficult to digest. Besides, nature's first food for a calf contains none. In adjusting the balance of the food it will be wise again to appeal to nature, and take cow's milk as a guide. While no hard-and-fast rules need be observed regarding the amount of oil, a fair proportion of the non-nitrogenous part of the food should be in this form. These restrictions narrow the selection of ingredients for making calf meals to such substances as crushed linseed, linseed-cake meal, oatmeal, flour or fine wheat thirds, finely ground Indian meal, locust-bean meal, and fish meal. Dried separated milk has also been

claimed as a specific ingredient, but it is doubtful if it possesses sufficient merit to make it worth the high price that is usually put upon it. Condimental spices, while sometimes used, do not appear to be necessary, and are of doubtful value.

Artificial rearing is followed along three more or less distinct lines. The young calf may get mostly whole milk for three to four months, being taught meanwhile to eat linseed or other suitable food. A second line that has been pursued somewhat assiduously by modern experimenters is the use of either separated or skimmed milk along with some substitute for the butter fat removed. And lastly, in dairy districts, where milk in any form is considered to be too expensive, attempts are made to rear heifer calves for milking stock with little or no milk after the first week or two. To these it is proposed to add an account of another method, which may be regarded as a blend of the first and the last, the object being to rear a maximum of good calves on a minimum of milk.

Rearing on Whole Milk.

Whole milk alone has long been regarded as an expensive food for calves, and it was partly at least the recognition of this that induced many to discontinue the rearing of cattle. The numerous calf-rearing experiments that have been conducted in recent times provide very conclusive evidence of the costliness of whole milk as a producer of calf flesh. It has generally been used in these tests as a set-off against the various foods tried, and the results all demonstrate without doubt that whole milk produces live weight on the young calf at a very high cost per unit as compared with substitutes. No better illustration of this fact can be cited than the experiments carried out very thoroughly three years in succession by the Department of Agriculture and Technical Instruction for Ireland.¹

In these experiments one lot in each series received whole milk, and although it was put at the very low value of 4½d. per gallon and fed with moderation and skill, the allowance at no time exceeding 1½ gallons per day, the cost of producing live weight increase with it was over 31s. per cwt., whereas with the separated milk and substitutes it was about 13s. The recent experiments² carried out by the Royal Agricultural Society of England, and many others, prove the same point. These experiments all provide equally clear proof that whole

¹ 'The Journal of the Dept. of Agriculture and Technical Instruction for Ireland,' vol. v., No. 3, 1905.

² See 'Journal of the Royal Agricultural Society of England,' vol. 75, 1914.

milk takes the lead in making good calves. The doubtful point, one of great practical importance, appears to be whether the favourable start given by the whole milk is an impetus that carries the calf more successfully through life, or whether it amounts merely to so many extra pounds produced in calthood at an extra cost. When experimental feeding is continued after weaning, as it has been done in several cases, the whole-milk calves generally maintain the lead obtained in calthood, and the question at issue is—do they turn the food they receive in after life to better account and thrive better? Many practical people, judging by appearance, are inclined to maintain that they do. In order to test this point, some experiments have been continued after the calves were weaned, and it has been found that calves reared on whole milk generally maintain the lead right through to the fattening period; but although in some cases whole-milk calves have proved better thrivers, the experimental evidence on the whole points to the conclusion that those reared on separated milk and substitutes are in no way so impaired by their rearing that in ordinary circumstances of after life do they lose much of the saving effected by the use of substitutes in rearing them. Any evidence to the contrary seems rather to warrant the presumption that the substitutes have not been skilfully used. Indeed, investigations afford much support to the view that with skill and proper care, whole milk, or even any large quantity of milk of any kind, is not essential in calf rearing; but notwithstanding many experiments there is still much uncertainty about the best substitutes.

Separated Milk and Butter Fat Substitutes.

Skim milk would be used, more or less, in calf rearing as early as any attempt was made to bring up calves by artificial means; and while there is no doubt about its value as a food, the rapid changes which milk undergoes on keeping leads to great variety in the results obtained from its use, and to the production of many badly reared calves. Skim milk is still in use on many farms; and where due care is taken to keep the milk sound and wholesome, and to use it with care and moderation while it is still fresh, it is one of the best foods for calves, especially when used with a little linseed-meal.

Skim milk has the advantage of still containing about 25 per cent of the original butter fat, and it is the more digestible part of it, being the smaller fat globules. On the other hand, the best butter fat for making butter is the large globules which with proper handling rise quickly to the surface of the milk. Probably too great anxiety to get a larger yield of butter leads

to allowing the milk to stand for more than ten or twelve hours, with the result that changes take place which profoundly affect the quality of the milk. This, along with carelessness in the feeding, brings about digestive troubles which, as a rule, are the cause of the variable results obtained with a food that should never fail. But be this as it may, in recent times attention has been concentrated on the use of machine-separated milk rather than hand-skimmed milk. This food when produced on the farm has the merit of being uniform in quality, and stands a chance of being fed at a more uniform temperature than skim milk; but it suffers from the drawback of containing little butter fat, and a great deal of research has been conducted with the object of finding the best substitute for the butter fat.

Generally speaking, calf rearers do not have an exalted opinion of separated milk. As a rule, those unacquainted with its composition and proper use are inclined to judge it by its appearance compared with whole milk. This, however, is a mistaken idea. Calf rearers should realise that separated milk, although poor and watery in appearance, is by no means a poor food. The separator removes practically nothing but the fat, which is not the most important ingredient from the point of view of calf rearing, and therefore separated milk contains all the other valuable constituents in the proportion and in the same condition as they are in whole milk. Failure to grasp this point, along with a low opinion generally of its merits, has led many to try to make up for what they conceived to be want of quality by means of a more liberal quantity, and this has led to not a few failures in its use; for the excess of nitrogenous food provided in this way speedily leads to stomachic trouble, with the result that the calves cease to thrive and become pot-bellied. The cardinal principle in the successful utilisation of separated milk for calf rearing is to use it sound and fresh, restricting the quantity to what would be allowed were the calves being reared on whole milk. Used in this way it is an ample and excellent source of the protein, carbohydrates (milk sugar), and mineral matter required by the calf, and also provides the peculiar dietetic influence which appears to be inherent in milk as an article of diet, particularly for young animals. What is wanted is a substitute for the fat that has been removed.

Oil Substitutes.

In the search for a substitute for the butter fat of milk, a much favoured line of investigation has been the trial of various oils. The most favoured of them appears to have been cod-liver oil. Probably its use as human food, and the belief

that it would be more digestible in the economy of the calf than vegetable oils, have had some influence in the partiality for it. In experiments it has given good results repeatedly, and has the further advantage of being easily used; but favourable as these factors are, recent research shows that cod-liver oil has no monopoly of being specially suitable for calf rearing. The experiments¹ conducted recently by Professor Hendrick, in which cotton-seed oil was tested against cod-liver oil, show that a vegetable oil may also be used with success in calf rearing. Oils, however, although suitable and economical for calf rearing, are all open to the objection that they can be used only in very limited quantities. They are no full substitute for the butter fat that has been removed from a calf's ration of milk, for a calf can seldom take more than two ounces of cod-liver oil per day, and in a gallon and a half of whole milk it usually gets half a pound or more of butter fat.

Meal or Grain Substitutes.

The most useful idea that recent experimental work in calf rearing has provided is not the great value of oils, but rather the possibility of meeting the calf's requirements by means of meals derived from grain—that is, of making the starch of cereals take the place of a considerable part of the butter fat of milk. By this means it is possible to put more nutriment into the calf and to make greater progress than with oil substitutes, which, if used freely, readily bring about too great laxity in the passage of the bowels. Among the first experiments on a large scale to demonstrate this point were those by the Department of Agriculture and Technical Instruction for Ireland, to which reference has already been made. In these experiments Indian meal easily surpassed cod-liver oil, both in the actual amount of increase produced and in the cost per cwt. Also a meal mixture composed of two parts by weight of Indian meal, two parts of oatmeal, and one part of pure ground flax seed, proved very strikingly to be the best of the substitutes tried in these investigations. Then again, in another recent experiment already referred to as having been conducted by the Royal Agricultural Society of England with the object of finding how separated milk could best be utilised in calf rearing, the best results were obtained with crushed oats.

The favourable results that have been obtained with grain meals as a substitute for butter fat may be said to be as remarkable as they were unexpected. It is quite true that many

¹ 'Transactions of Highland and Agricultural Society,' vol. xxv., Fifth Series, 1913, p. 259.

attempts have been made in dairy districts to rear calves with calf meals or grain rations, but in that case the circumstances made the calf rearer aim at a substitution for milk rather than for butter fat, and the experience in that line, speaking generally, scarcely led any one to think of the suitability of the grain ration as a substitute for butter fat.

The Possibilities of a Compromise.

The interpretation of experimental calf feeding as outlined above, and particularly the circumstances of the east and south-east of Scotland, suggested to the writer some time ago the idea of a compromise. In the district referred to one of the greatest objections to calf rearing by artificial means is a somewhat exaggerated idea of the amount of milk, either separated or whole, that is essential. It is supposed that in order to rear many calves a considerable number of cows must be kept. In this connection reference may be made to the calf rearing described in Leaflet No. 142 of the Board of Agriculture and Fisheries, which has been recently recommended by the Board of Agriculture for Scotland in connection with increased production of food. According to the method outlined in that leaflet, 400 gallons of milk, either whole or separated, is used for each calf, so that the output would be limited to about one calf and a half to each cow. In the east of Scotland, and no doubt in other districts where dairy Shorthorns are kept, many good calves are available for rearing, but few farmers see their way to keep cows for this purpose. If the farmers are to undertake the rearing of them, some method must be devised for doing it with a minimum of milk. Moreover, the method of handling the milk must be simple, because in many cases this will have to be undertaken by the man in charge of the cattle. This practically precludes any system in which the milk is not used up at once.

After rearing calves tentatively for a few years with the object of overcoming the difficulties referred to, the writer conceived the idea of limiting the milk to 100 gallons of whole milk per calf. This limitation of course makes it possible, with a good milch cow, to rear about eight calves per cow. No difficulty has been experienced, and last season the writer actually reared sixteen calves on less than the milk of two cows; and Mr George Bertram Shields, experimenting in the same direction, at Dolphingston, Tranent, has for two or three years in succession reared and brought forward to the grass ten spring calves on the milk of one cow, along with calf meal, cake, and grain.

Scheme for Rearing Calves on 100 Gallons of Milk.

The scheme worked out and followed by the writer is as follows:—

	Sweet Milk.		Gruel.		Linseed-cake and Bran or Bruised Oats	
	Gallons daily.	Gallons weekly	Pints daily	Pints weekly.	Lb daily	Lb. weekly.
1st week	$\frac{3}{4}$ — $1\frac{1}{2}$	8	—	—	—	—
2nd "	$1\frac{1}{2}$	$10\frac{1}{2}$	—	—	—	—
3rd "	$1\frac{1}{2}$	$10\frac{1}{2}$	$1\frac{1}{2}$	10	—	—
4th "	$1\frac{1}{2}$	$10\frac{1}{2}$	2	14	—	—
5th "	$1\frac{1}{2}$	$8\frac{1}{2}$	3	21	—	—
6th "	$1\frac{1}{2}$	$8\frac{1}{2}$	3	21	—	—
7th "	1	7	3	21	$\frac{1}{2}$	$1\frac{1}{2}$
8th "	1	7	4	28	$\frac{3}{4}$	$2\frac{1}{4}$
9th "	$\frac{3}{4}$	$4\frac{1}{2}$	4	28	$\frac{3}{4}$	$2\frac{1}{4}$
10th "	$\frac{3}{4}$	$4\frac{1}{2}$	4	28	$\frac{3}{4}$	$3\frac{1}{4}$
11th "	$\frac{3}{4}$	$4\frac{1}{2}$	5	35	$\frac{3}{4}$	$3\frac{1}{4}$
12th "	$\frac{3}{4}$	$3\frac{1}{2}$	6	42	$\frac{3}{4}$	$3\frac{1}{4}$
13th "	$\frac{3}{4}$	$3\frac{1}{2}$	6	42	$\frac{3}{4}$	$5\frac{1}{4}$
14th "	$\frac{3}{4}$	$3\frac{1}{2}$	4	28	1	7
15th "	$\frac{3}{4}$	$3\frac{1}{2}$	$\frac{1}{2}$	28	1	7
16th "	$\frac{1}{4}$	$1\frac{1}{2}$	4	28	1	7
		100		374		43
				= 47 gallons gruel.		
				= 88 lb. calf meal.		

Calf meal—

Linseed-cake meal	.	.	.	.	4 parts
Crushed linseed .	.	.	.	.	2 parts
Wheat parings .	.	.	.	.	1 part
Locust-bean meal	.	.	.	.	1 part

Calf gruel—

Make 2 to 3 lb. of the calf meal into a paste with 1 quart of cold water, and add 1 gallon of boiling water. Feed at blood heat, and allow $\frac{1}{4}$ oz. salt per calf per day.

The milk and gruel are fed in equal quantities, three times daily, up to 8 or 9 weeks. Then at twice daily, making the cake and corn the third meal. Good sweet hay should be allowed from 4 weeks onward, and sliced turnips or grass according to season as soon after as the calf cares to eat them. After 16 weeks the calves may be weaned and go to grass, and continue to receive 1 to 2 lb. of a mixture of concentrated food. If in winter sliced turnips and hay should be given, along with $1\frac{1}{2}$ to 2 lb. of a mixture of linseed-cake and bran, bruised oats, or other suitable food. With backward calves it may be expedient to continue gruel and a small quantity of milk longer. After weaning, the rations used are as follows:—

6 months calves—

At grass.—1-2 lb. of mixture of linseed-cake, bran, bruised oats or dried grains.

In house.—Concentrated food as on grass, and about 14-21 lb. turnips and 7 lb. hay.

9-12 months calves—

At grass.—3 lb. of mixture of concentrated feeding-stuff.

In house.—3 lb. of mixture of concentrated feeding-stuff, with 4 lb. cut hay and 6-7 lb. oat straw and 28-42 lb. turnips.

Good calves should be between 6 and 7 cwt. at 12 months.

The Governors of the Edinburgh and East of Scotland College of Agriculture recently undertook an experiment in calf rearing, which is being conducted according to this scheme at the College Farm, Dreghorn Mains. Two good dairy Shorthorn cows were got for this purpose, and the experiment was commenced in January with good non-pedigree Shorthorn calves, which were obtained direct from the north of England. Four were secured on 14th January, two were taken in on 21st January, and others followed as required until in April there were twelve. Eight were weaned and ready to go to grass in May. The calves have thriven well, and the weights of the first six, which are given here, indicate the results that can be obtained by this method of rearing. The calves were about a week old when received direct from Westmoreland, and would average about 80 lb. each. The increases made during the first three months of the experiment were as follows:—

No.	Received.	Increase on Feb. 14.	Increase on March 13.	Increase on April 10.	Total Weight, April 10.	Average L. W. I. per head per day.
1	Jan. 14	52 lb.	48 lb.	44 lb.	221 lb.	1·67 lb.
2	"	63 "	42 "	34 "	219 "	1·64 "
3	"	37 "	44 "	46 "	207 "	1·51 "
4	"	72 "	49 "	39 "	240 "	1·90 "
5	Jan. 21	42 "	42 "	36 "	200 "	1·55 "
6	"	38 "	37 "	37 "	192 "	1·45 "

The experiment is still in progress, and no doubt will provide useful information when completed. The writer is indebted to the Governors of the College for permission to make use of these figures; he also desires to gratefully acknowledge the assistance rendered by others named in this article.

MILK RECORDS.

THIRTEENTH YEAR—RECORDS OF 26,572 COWS.

By WILLIAM STEVENSON, B.Sc., N.D.A., N.D.D., Superintendent of Milk Records to the Scottish Milk Records Association.

SYSTEMATIC Milk Recording in Scotland was continued in 1915 on the same lines as in 1914 and previous years. The work was carried on under the direction of The Scottish Milk Records Association as in 1914.

The Association in 1915 consisted of the following members:—

Name and Address.	Body Represented.
Mr J. S. Paterson, Quhytewoolen, Lockerbie	{ Annandale Milk Record Society.
Mr J. W. Inglis, Oakbank, Lamlash	{ Arran Milk Record Society.
Mr William Niven, Smithstone, Maybole	{ Ayr and Stair Milk Record Society.
Mr W. D. M'Cubbin, Lochlands, Maybole	{ Carrick Milk Record Society.
Mr John Young, Skerrington Mains, Hurlford	{ Central Ayrshire No. 1 Milk Record Society.
Mr William Taylor, Fortacres, Dundonald	{ Central Ayrshire No. 2 Milk Record Society.
Mr James Symington, Kersepark, Hollybush	{ Coylton and District Milk Record Society.
Mr John Sloan, Creoch, New Cumnock	{ Cumnock Milk Record Society.
Mr A. Y. Allan, Aitkenbar, Dumbarton	{ Dumbartonshire Milk Record Society.
Mr James Osborne, Ryemuir, Lochmaben	{ Dumfries and District Milk Record Society.
Mr John Murray, Kilfillan, Glenluce	{ Dunragit Milk Record Society.
Mr William Middlemas, Town Clerk's Office, Kilmarnock	{ Fenwick (High) Milk Record Society.
Mr David Sillars, Low Todhill, Fenwick	{ Fenwick (Laigh) Milk Record Society.

Name and Address.	Body Represented.
Mr J. W. Miller, Earlseat, West Wemyss	{ Fife Milk Record Society.
Mr J. Finnie, Camphill, Dalry	{ "John Speir" Milk Record Society.
Mr William Taylor, Mulindry, Bridgend, Islay	{ Kintyre and Islay Milk Record Society.
Mr Robert Paton, Mains of Airies, Stranraer	{ Kirkcolm and District Milk Record Society.
Mr John M'Caig, Belmont, Stranraer	{ Kirkcolm and Leswalt Milk Record Society.
Mr W. M. Menzies, Estate Office, Ardwell, Stranraer	{ Kirkmaiden & Stoneykirk Milk Record Society.
Mr Gavin Hamilton, British Linen Bank, Lesmahagow	{ Lesmahagow Milk Record Society.
Mr James Barr, Glasnick, Kirkcowan, Newton Stewart	{ Lower Wigtownshire (Newton Stewart District) Milk Record Society.
Mr Alex. Edgar, Chapelheron, Whithorn	{ Lower Wigtownshire Milk Record Society.
Mr William Wallace, Auchenbrain, Mauchline	{ Mauchline Milk Record Society.
Mr Thomas Barr, Hobsland, Monkton	{ Monkton and District Milk Record Society.
Mr David Goldie, Little Shewalton, Irvine	{ Montgomerie Milk Record Society.
Mr James Moffat, Gateside, Sanquhar	{ Nithsdale Milk Record Society.
Mr John A. Carlyle, 2 Addison Place, Arbroath	{ North of Scotland Milk Record Society.
Mr John Jamieson, Langholm, Ochiltree	{ Ochiltree Milk Record Society.
Mr Robert M. Reid, Toward Farm, Toward	{ Renfrewshire (Lower Ward) and Bute Milk Record Society.
Mr Robert Wilson, Craig, Neilston	{ Renfrewshire (Upper Ward) Milk Record Society.

Name and Address.	Body Represented.
Major J. A. Houison - Craufurd, Dunlop House, Dunlop	} Stewarton and Dunlop Milk Record Society.
Mr J. G. M'Myn, Kirkhouse, Kirkbean, by Dumfries	
Mr H. W. B. Crawford, Chapmanton, Castle-Douglas	} Stewartry of Kirkcudbright Milk Record Society, Circuits 1, 2, and 3.
Mr W. P. Gilmour, Balmangan, Kirkcudbright	
Mr John Paterson, Woodend, Balfon	} Strathendrick, Kirkin-tilloch and District Milk Record Society.
Mr Thomas Clement, of Netherton, 64 Albion Street, Glasgow	
Mr James Howie, Hillhouse, Kilmarnock	} The Ayrshire Cattle Herd-Book Society.
Mr Thomas C. Lindsay, Aitkenbrae, Monkton	
Mr A. W. Montgomerie, Lessnessock, Ochiltree	
Mr Matthew Bowie, Blackbyres, Barrhead, near Glasgow	} The British Holstein-Friesian Cattle Society.
Mr Hugh Brown, Colton Mains, Dunfermline	
Mr F. N. M. Gourlay, of Milnton, Tynron, Thornhill	} The Shetland Cattle Herd-Book Society.
Mr R. W. R. Mackenzie, of Earlsall, Leuchars, Fife	
Mr Alex. Cross, of Knockdon, 19 Hope Street, Glasgow	} The Highland and Agricultural Society.
Mr John M'Caig, Belmont, Stranraer	
Sir Hugh Shaw Stewart, Bart., of Ardgowan, Inverkip	
Major J. A. Houison - Craufurd, Dunlop House, Dunlop	} The West of Scotland Agricultural College.
Mr Charles M. Douglas, of Auchlochan, Lesmahagow	
Principal W. G. R. Paterson, 6 Blythswood Square, Glasgow	
Mr Wm. Bruce, 13 George Square, Edinburgh	} The Edinburgh and East of Scotland College of Agriculture.
Mr David Dow, Balmanno, Bridge of Earn	
Mr Alex. M'Callum, 13 George Square, Edinburgh	

Name and Address.	Body Represented.
Mr G. G. Esslemont, 4½ Union Street, Aberdeen	The North of Scotland College of Agri- culture.
Professor Hendrick, Marischal College, Aberdeen	
Dr J. F. Tocher, 41½ Union Street, Aberdeen	
Mr John Drysdale, 5 St Andrew Square, Edinburgh	Co-opted Members.
Mr James Dunlop, Strathblane, Prestwick	

Chairman—Mr Charles M. Douglas.

The following are the principal members of the staff:—

Secretary and Treasurer—Mr John Howie.

Superintendent—Mr William Stevenson, B.Sc., N.D.A., N.D.D.

Assistant-Superintendent—Mr William Lennox, N.D.D.

Administration.

In 1915, as in previous years, the Association's milk recording was administered through Local Milk Record Societies. The grant for milk recording from the Development Fund of not more than £2000, obtained through the Board of Agriculture for Scotland in 1914, was continued in 1915 on the same conditions as formerly, with the exception that no Milk Record Society that had received grants from the Development Fund or other sources for four years was eligible for further assistance from the Fund. In 1914 all local societies of more than two years' duration received a grant of £10; but the Development Commissioners considered that farmers who had already had their cows tested for four years or longer ought to be fully alive to the pecuniary benefits of the scheme, and to be willing to continue with the assistance of the organisation and other benefits offered by the Association, without the inducement of a direct money grant from public funds.

The Ayrshire Cattle Herd-Book Society continued their grant of £40 to the Association.

Grants were allocated to local societies on the following scale:—

- (a) To societies in their First Year.—An annual grant of £35, and the hire of the necessary milk-testing appliances free of annual charge; the society to upkeep the apparatus in good condition,

- (b) To societies in their Second Year.—An annual grant of £35.

A full grant to be given for tests at intervals of not more than 21 days; 75 per cent thereof for tests at intervals of from 21 to 28 days; no grants to be given where the intervals between the tests exceed 28 days.

- (c) To societies in their Third or Fourth Year.—An annual grant of £10.

Owing to the resignation of members at the end of 1914, mainly on account of the war, five local societies intimated that they were unable to continue as separate societies in 1915. Three new societies were, however, formed during the year—viz., Ayr and Stair, Dumfries and District, and The North of Scotland, and members of discontinuing societies amalgamated to form other two societies. Thus, for the five societies discontinuing at the end of 1914, other five societies were obtained in 1915.

The total number of milk record societies in 1915 was 35, and 35 trained recorders were constantly employed during the greater part of the year, compared with 36 in 1914, the difference being accounted for by the fact that the Stewartry County Society, which formerly employed four recorders, arranged for each of their recorders to test a larger number of cows, so that in 1915 three recorders in the Stewartry tested the same number of herds as the four recorders in 1914. The total number of herds tested in 1915 was 642, compared with 641 in 1914. The total number of cows tested in 1915 was 26,572, compared with 26,424 in the previous year.

The following is a list of the Milk Record Societies which operated in 1915, with the name and address of the secretary of each society :—

Name of the Society.	Secretary.
Annandale . . .	Mr John Henderson, Banker, Lockerbie.
Arran . . .	Mr James Bone, jun., Glenkiln, Lamlash.
Ayr and Stair . . .	Mr Quintin Dunlop, Greenan, Ayr.
Carrick . . .	Mr John Stevenson, jun., Balig, Ballantrae.
Central Ayrshire No. 1	Mr James Howie, Hillhouse, Kilmarnock.
Central Ayrshire No. 2	Mr William Taylor, Fortacres, Dundonald.
Coylton and District .	Mr William Logan, Southcraig, Patna.
Cumnock . . .	Mr Alex. Arthur, Benston, New Cumnock.
Dumbartonshire .	Mr John Bilsland, Quay Place, Dumbarton.
Dumfries and District	Mr John Henderson, Banker, Lockerbie.

Name of the Society.	Secretary.
Dunragit . . .	{ Mr T. Campbell Gilmour, Estate Office, Dunragit.
Fenwick (High) .	Mr James Mather, Low Gainford, Fenwick.
Fenwick (Laigh) .	Mr William Jack, Tannacrief, Kilmarnock.
Fife . . .	Mr Wm. Macniven, Royal Bank, Kirkcaldy.
"John Speir" . .	Mr William Longwill, Hawhill, Dalry.
Kintyre and Islay .	Mr A.S. Paterson, Royal Bank, Campbeltown.
Kirkcolm and District	Mr James A. Gilmour, Southcairn, Stranraer.
Kirkcolm and Leswalt	Mr John M'Caig, Belmont, Stranraer.
Kirkmaiden & Stoney- kirk	{ Mr William Findlay, Cairnhandy, Ardwell.
Lesmahagow . . .	{ Mr Gavin Hamilton, British Linen Bank, Lesmahagow.
Lower Wigtownshire (Newton Stewart District)	{ Mr William Christison, Barglass, Kirkinner.
Lower Wigtownshire (Whithorn District)	{ Mr William Christison, Barglass, Kirkinner.
Mauchline . . .	Mr Wm. Wallace, Auchenbrain, Mauchline.
Monkton and District	Mr William Howie, Brieryside, Monkton.
Montgomerie . . .	Mr David Goldie, Little Shewalton, Irvine.
Nithsdale . . .	Mr John Henderson, Banker, Lockerbie.
North of Scotland .	{ Mr John A. Carlyle, 2 Addison Place, Arbroath.
Ochiltree . . .	{ Mr A. W. Montgomerie, Lessnessock, Ochil- tree.
Renfrewshire (Lower Ward) and Bute	{ Mr Alex. Blair, 40 Rue End Street, Greenock.
Renfrewshire (Upper Ward)	{ Mr J. Campbell Murray, 216 West George Street, Glasgow.
Stewarton and Dunlop	Mr John Littlejohn, Buistonend, Kilmaurs.
Stewartry Nos. 1, 2, and 3	{ Mr Patrick Gifford, Solicitor, Castle-Douglas.
Strathendrick, Kirkin- tilloch, and District	{ Mr John Paterson, Woodend, Balfon.

Season 1915.

The following table shows for each Society the number of members, the number of cows tested, the interval between the tests, and the duration of the recording season :—

Name of the Society.	No. of Members.	Number of Cows Tested.	Interval between Tests, in days.	Duration of Recording Season, in weeks.
1. Annandale	23	967	27	52
2. Arran	27	227	28	38
3. Ayr and Stair	17	676	21	52
4. Carrick	16	717	21	52
5. Central Ayrshire, No. 1 .	17	684	21	52
6. Central Ayrshire, No. 2 .	18	670	21	52
7. Coylton and District . .	17	486	20	52
8. Cumnock	18	620	21	52
9. Dumbartonshire	17	717	20	52
10. Dumfries and District . .	19	740	21	52
11. Dunragit	15	1042	21	51
12. Fenwick (High)	18	646	21	52
13. Fenwick (Laigh)	17	754	21	52
14. Fife	17	734	20	52
15. "John Speir"	26	719	28	52
16. Kintyre and Islay	24	951	28	42
17. Kirkcolm and District . .	15	951	21	52
18. Kirkcolm and Leswalt . .	17	947	21	51
19. Kirkmaiden and Stoneykirk	19	1465	27	46
20. Lesmahagow	23	694	28	52
21. Lower Wigtownshire (New- ton Stewart District) . . .	13	610	17	48
22. Lower Wigtownshire (Whit- horn District)	15	826	19	48
23. Mauchline	17	643	20	52
24. Monkton and District . .	13	598	21	52
25. Montgomerie	25	857	28	52
26. Nithsdale	23	1001	27	52
27. North of Scotland	5	206	28	40
28. Ochiltree	18	476	20	52
29. Renfrewshire (Lower Ward) and Bute	17	466	21	52
30. Renfrewshire (Upper Ward)	16	695	20	52
31. Stewarton and Dunlop . .	23	886	28	52
32. Stewartry, No. 1	20	1177	27	52
33. Stewartry, No. 2	21	1131	28	52
34. Stewartry, No. 3	19	1129	24	52
35. Strathendrick, Kirkintilloch, and District	17	464	21	52
Total No.	642	26,572		

Definitions.

The milk records compiled by the Association are records of the estimated quantity of milk produced by each cow in a separate lactation and of the estimated percentage of milk-fat contained in the milk. For convenience a gallon of milk is reckoned as 10 lbs. A gallon of milk of average quality weighs almost exactly $10\frac{1}{2}$ lbs. The following further particulars concerning each record are also given, wherever possible:—

- Name of cow, byre number, and herd-book number.
- Sire of cow, and herd-book number of sire.
- Dam of cow, and herd-book number of dam.
- Age of cow at opening of record.
- Date of calving preceding opening of record.
- Number of weeks in milk.
- Date of next calving after record closed.

The following particulars of the preceding record are appended to each record, where available:—

- Date of calving preceding opening of record.
- Quantity of milk in gallons.
- Percentage of fat in milk.
- Number of weeks in milk.

The milk yields were estimated in respect of quantity and milk-fat percentage from the results of systematic periodic tests by trained recorders. The recorders visited the farms for this purpose at intervals varying from 14 to not more than 28 days, and each day of visit was regarded as the middle day of the period covered by the visit. Milk records estimated in this way approximate closely to the actual milk yields.

Classification of Records.

The records were classified into three groups for cows and heifers respectively, on the same basis as in the last five annual reports. Experience has confirmed the view that a very useful comparison is obtained by reckoning the yields at their estimated equivalent in milk of 1 per cent of milk-fat. Such a comparison takes into consideration both the quantity and quality of the milk.

Cows with a milk record equivalent to not less than 2500 gallons at 1 per cent of fat, and heifers with a milk record equivalent to not less than 2000 gallons at 1 per cent of fat, were grouped into Class I. Cows and heifers with milk records

of less than two-thirds of these amounts—i.e., 1660 and 1330 gallons respectively—were grouped into Class III.

The following short table shows the corresponding values of these yields in fairly good milk of 3·5 per cent milk-fat:—

Class.	Yield in Milk of 1 Per Cent Fat. (Gallons.)	Corresponding Yield in Milk of 3·5 Per Cent Fat. (Gallons.)
Cows in Class I. .	Not less than 2500	714
Heifers in Class I. .	Not less than 2000	571
Cows in Class III. .	Less than 1660	474
Heifers in Class III.	Less than 1330	380

All cows and heifers with milk yields falling between these limits would come into Class II. Such animals naturally claim less attention than the good milkers or the obviously unprofitable animals. In order to economise space, particulars of their records are not included in this report.

It should always be kept in mind, when making a comparison of cows in different districts, that the different conditions of soil and climate and the different methods of dairying practised have a considerable influence on the milk yields, and that therefore milk yields alone do not necessarily indicate the true relative inherent or hereditary milking qualities of the animals. But the authenticated milk records compiled by the Association ought to be of inestimable value to breeders and owners of dairy cows if properly interpreted.

MILK RECORD SOCIETIES APPROVED BY THE SCOTTISH MILK RECORDS ASSOCIATION IN 1915.

Annandale Milk Record Society.

This society was in its fourth year, and consisted of 23 members, as in the three previous years—the maximum number that could be conveniently served by one recorder on a 27 days' circuit. The number of cows tested was 967. Several other farmers in the district who desired to commence milk recording could not be provided for in the existing society, but were ultimately accommodated in the new Dumfries and Districts Society.

On some of the farms in this district milk is produced for direct sale, and cows calve at all seasons of the year. On other farms cheese is made during the summer months, and most of the cows calve in spring.

Recording was carried on throughout the whole year, the recorder visiting each farm at intervals of 27 days. One advantage of 27 as compared with 28 days tests is that each member has the visit of the recorder on a different day of the week on each round.

Of the 967 cows and heifers tested by this society, 508 cows and 213 heifers were included in Class I., and 14 cows and 9 heifers in Class III. Thus, of the total cows and heifers tested, 75 per cent were placed in Class I. and 2 per cent in Class III., an improvement of no less than 17 per cent and 2 per cent respectively from 1914.

Arran Milk Record Society.

This society was in its third year. The operations of the society were confined entirely to the island of Arran. Most of the dairy herds in Arran are very small, and in 1914 the Arran Society had considerable difficulty in carrying on the recording owing to the relatively high cost per cow. A special effort was made to enrol more members, and the membership was ultimately increased from 19 in 1914 to 27 in 1915. In some cases two small herds were tested by the recorder in one day. The number of cows tested was 227, an average of only 8.4 cows per member, but an increase of 28 cows from 1914.

In Arran milk is produced almost entirely for direct sale, chiefly for summer visitors, and most of the cows calve in the late spring. Butter is made when the milk is not all required, and on at least two of the larger farms cheese is made during summer.

The records dated from 13th March and covered a period of thirty-eight weeks. The recorder visited each farm at intervals of 28 days.

Of the 227 cows and heifers tested by this society, 13 cows and 1 heifer were included in Class I., and 23 cows and 14 heifers in Class III. Thus, of the total cows and heifers tested, 6 per cent were placed in Class I. and 16 per cent in Class III.

Ayr and Stair Milk Record Society.

This society was in its first year. The number of members was 17, one less than the full membership for a society conducting 21 days tests. A convenient rearrangement of members was effected with the five neighbouring societies in the

Mauchline, Cumnock, Ochiltree, Coylton, and Carrick districts, and a more compact society was formed than would otherwise have been possible. These six societies remain affiliated for the purpose of redistribution of members whenever necessary in order to avoid overlapping of circuits. The number of cows tested was 676.

On some of the farms in this district cheese is made during the summer months. On other farms milk is produced for direct sale, and a considerable proportion of the cows calve in autumn or winter.

Recording was carried on throughout the whole year. The recorder visited each farm at intervals of 21 days.

Of the 676 cows and heifers tested by this society, 230 cows and 98 heifers were included in Class I., and 30 cows and 7 heifers in Class III. Thus, of the total cows and heifers tested, 49 per cent were placed in Class I. and 5 per cent in Class III.

Carrick Milk Record Society.

This society was in its eighth year. The number of members was 16, one less than in the previous year. But this was due to the rearrangement of members on the formation of the new Ayr and Stair Society in the adjacent district. Two of the herds, however, required two days' testing on each visit, so that the recorder was fully employed for 18 days on each 21 days circuit. The number of cows tested was 717.

The members of this society were widely scattered from Maybole to beyond Ballantrae. On most of the farms cheese is made during the spring and summer months, but on some of the farms nearer to railway stations milk is produced for direct sale. Cows calve at all seasons, but the majority calve in spring.

Recording was carried on throughout the whole year. The recorder visited each farm at intervals of 21 days.

Of the 717 cows and heifers tested by this society, 191 cows and 77 heifers were included in Class I., and 59 cows and 2 heifers in Class III. Thus, of the total cows and heifers tested, 37 per cent were placed in Class I. and 9 per cent in Class III., an improvement of 1 per cent in each class from 1914.

Central Ayrshire No. 1 Milk Record Society.

(Hurlford, Galston, and Newmilns Districts.)

This society was in its eighth year. The 18 original members in 1908 were widely scattered from near Ayr to beyond

Kilmarnock, but since 1913, owing to the formation of other two societies in Central Ayrshire, the No. 1 Society has been confined chiefly to the Hurlford, Galston, and Newmilns districts. The number of members in 1915 was 17, one less than the full membership of the society. The number of cows tested was 684.

On most of the farms milk is produced for direct sale, but in a few cases cheese is made during the summer months. On the majority of the farms cows are calving at all periods of the year.

Recording was carried on throughout the whole year. The recorder visited each farm at intervals of 21 days.

Of the 684 cows and heifers tested by this society, 264 cows and 70 heifers were included in Class I., and 45 cows and 3 heifers in Class III. Thus, of the total cows and heifers tested, 49 per cent were placed in Class I. and 7 per cent in Class III., compared with 50 per cent and 6 per cent respectively in 1914.

Central Ayrshire No. 2 Milk Record Society.

(Craigie and Dundonald Districts.)

This society was confined chiefly to the districts of Craigie and Dundonald in Central Ayrshire. The society was in its third year. The number of members in 1915 was 18, the same number as in the two previous years, and the full membership of the society. The number of cows tested in 1915 was 670.

A number of the members of this society sell milk all the year round; a few make butter, and a considerable proportion make cheese during the spring and summer months. Cows calve at all seasons, but the most of them calve in the spring months.

Recording was carried on throughout the whole year. The recorder visited each farm at intervals of 21 days.

Of the 670 cows and heifers tested by this society, 224 cows and 79 heifers were included in Class I., and 43 cows and 7 heifers in Class III. Thus, of the total cows and heifers tested, 45 per cent were placed in Class I. and 7 per cent in Class III.; an improvement of 4 per cent and 2 per cent respectively from 1914.

Coylton and District Milk Record Society.

This society was in its second year. There was a considerable change in the membership of the society in 1915, owing to the formation of the new Ayr and Stair Society in the

adjacent district. The former Stair members, and a few others, were transferred to the new society, while new members in the more immediate neighbourhood were taken into the Coylton and District Society. The society agreed to change the interval between tests from 21 days in 1914 to 20 days. Testing at intervals of 20 days offers several advantages. Each member has the visit of the recorder on a different day of the week on each round, while the interval between tests is not unduly long so as to interfere with the reliability of the records; also calculating is simplified, as each half pound of milk daily represents one gallon in 20 days. The number of members in 1915 was 17; the full membership for a society conducting 20 days tests. The number of cows tested was 486.

On most of the farms in this district cheese is made during the summer season. On a few of the farms milk is produced for direct sale all the year round.

Recording was continued throughout the whole year. The recorder visited each farm at intervals of 20 days.

Of the 486 cows and heifers tested by this society, 305 cows and 106 heifers were included in Class I., and 6 cows and 2 heifers in Class III. Thus, of the total cows and heifers tested, 85 per cent were placed in Class I. and 2 per cent in Class III.; an improvement of no less than 23 per cent and 2 per cent respectively from 1914.

The Coylton and District Society had the distinction of having the largest percentage of cows eligible for Class I. of all the societies in 1915. In 1914 this distinction was shared by the Ochiltree Society and the Mauchline Society.

Cumnock Milk Record Society.

The Cumnock Society is one of the two milk record societies in Scotland which have operated continuously since 1905, and have completed eleven years of recording, though some of the members of the original Cumnock Society are now members of other societies, while new members in the more immediate neighbourhood have come in. The number of members in 1915 was 18, the full membership of the society. The number of cows tested was 620.

The great majority of the cows in this district calve in the early spring, and cheese-making is general during the summer season. On some of the farms milk is sold during the autumn and winter months, and some of the cows calve towards the end of the year.

Recording was continued throughout the whole year. The recorder visited each farm at intervals of 21 days.

Of the 620 cows and heifers tested by this society, 248 cows

and 116 heifers were included in Class I., and 12 cows and 3 heifers in Class III. Thus, of the total cows and heifers tested, 59 per cent were placed in Class I. and 2 per cent in Class III.; an improvement of 12 per cent and 2 per cent respectively from 1914.

Dumbartonshire Milk Record Society.

This society was in its third year. The membership was 17, the same number as in the two previous years, and the full membership for a society conducting 20 days tests. The number of cows tested was 717, practically the same number as in 1914.

In this district milk is sold all the year round, and cows calve at all seasons.

Recording was carried on during the whole year. The recorder visited each farm at intervals of 20 days.

Of the 717 cows and heifers tested by this society, 194 cows and 63 heifers were included in Class I., and 45 cows and 1 heifer in Class III. Thus, of the total cows and heifers tested, 36 per cent were placed in Class I. and 6 per cent in Class III.; an improvement of 1 per cent and 3 per cent respectively from 1914.

Dumfries and District Milk Record Society.

This society was in its first year. The number of members was 18, and one of the herds required two days' testing on each visit. The society was formed to accommodate a number of new applicants for milk recording in different parts of Dumfriesshire. From 1912 two societies operated in the county, each with a full membership for 27 days tests, but during the two years previous to 1915 a few farmers who wished to commence milk recording could not be accommodated in either of the existing societies. At the beginning of 1915 a sufficient number of new applicants were obtained to form a new society in the Dumfries and surrounding districts. The society was necessarily a somewhat widely scattered one, but the recorder was able to visit all the herds of members by means of a suitable pony and trap. It is hoped that some rearrangement of membership with the other two societies in the county may be effected in the future, so as to avoid, as far as possible, all overlapping of circuits. The number of cows tested was 740.

Most of the members of this society make cheese during the summer season, and the majority of the cows calve in spring. On some of the farms milk is produced for direct sale all the year round, and cows calve at all seasons.

Recording was carried on throughout the whole year. The recorder visited each farm at intervals of 21 days.

Of the 740 cows and heifers tested by this society, 86 cows and 24 heifers were included in Class I., and 92 cows and 12 heifers in Class III. Of the total cows and heifers tested, 15 per cent were placed in Class I. and 14 per cent in Class III. Thus it will be seen that the members of this new society have a considerable leeway to make up before they reach the standard attained by some of the older societies.

Dunragit Milk Record Society.

This society was inaugurated in 1908 and was in its eighth year, though only four of the original members in 1908 were to be found in the same society in 1915. The number of members in 1915 was 15, four of the herds requiring two days' testing on each visit. The number of cows tested was 1042, the largest number tested by one recorder on a 21 days circuit in 1915. The district is mainly a cheese-making one, and the great majority of the cows calve in early spring, though on some of the farms a proportion calve in autumn or winter.

The records dated from the beginning of January, and covered the whole year with the exception of a week at the end of December, when very few cows were in milk. The recorder visited each farm at intervals of 21 days.

Of the 1042 cows and heifers tested by this society, 420 cows and 90 heifers were included in Class I., and 23 cows but no heifers in Class III. Thus, of the total cows and heifers tested, 49 per cent were placed in Class I. and 2 per cent in Class III.; an improvement of no less than 15 per cent and 5 per cent respectively from 1914.

Fenwick (High) Milk Record Society.

A milk record society has been in operation in the Fenwick district since 1905. In 1913 the large number of new applicants could not all be accommodated in one society, so the district was divided and a second society—the High Fenwick—formed. The High Fenwick Society in 1915 was in its third year and consisted of 18 members, an increase of 1 member from 1914. The number of cows tested was 646, an increase of 49 from the previous year.

The milk produced by the members of this society is chiefly for direct sale or butter-making, and cows calve at all periods of the year.

Recording was carried on during the whole year. The recorder visited each farm at intervals of 21 days.

Of the 646 cows and heifers tested by this society, 266 cows and 101 heifers were included in Class I., and 9 cows and 4 heifers in Class III. Thus, of the total cows and heifers tested, 57 per cent were placed in Class I. and 2 per cent in Class III.

Fenwick (Laigh) Milk Record Society.

This, the Fenwick parent society, is one of the only two societies which have operated continuously since 1905, and have completed eleven years of milk recording. The number of members in 1915 was 17. The number of cows tested was 754.

Practically all the milk produced by the members of this society is for direct sale or butter-making, and cows calve all the year round.

Recording was carried on during the whole year. The recorder visited each farm at intervals of 21 days.

Of the 754 cows and heifers tested by this society, 242 cows and 135 heifers were included in Class I., and 16 cows and 14 heifers in Class III. Thus, of the total cows and heifers tested, 50 per cent were placed in Class I. and 4 per cent in Class III.; an improvement of 1 per cent in each class from 1914.

The Fife Milk Record Society.

This society was in its third year. The number of members in 1915 was 17, the full membership for a society conducting 20 days tests, but a decrease of one member from the previous year. The number of cows tested was 734, an increase of 76 from 1914.

Practically the whole of the milk produced in this district is for direct sale, and cows calve all the year round.

Recording was continued during the whole year. The recorder visited each farm at intervals of 20 days.

Of the 734 cows and heifers tested by this society, 310 cows and 82 heifers were included in Class I., and 23 cows and 2 heifers in Class III. Thus, of the total cows and heifers tested, 53 per cent were placed in Class I. and 3 per cent in Class III.; an improvement of 6 per cent and 7 per cent respectively from 1914.

"John Speir" Milk Record Society.

(Dalry and Kilbirnie Districts.)

This society was instituted in 1910, and at that time the members were scattered over a very wide dairying district, or

series of districts, from Dundonald and Kilmarnock in the south to as far as Dumbarton and Helensburgh in the north. Original members of this society are now included in a number of other local societies. In 1915 the society was in its sixth year. The membership was confined mainly to the Dalry and Kilbirnie districts of Ayrshire, and the number of members was 25, one more than the full membership for a society conducting 28 days tests. This was one of the two societies with the largest membership in 1915. The chief advantage of a large society is, of course, the smaller cost of the records per member, but against this has to be placed the wider margin of error in the records due to the longer interval between the tests. The number of cows tested by this society in 1915 was 719.

Practically the whole of the milk produced by the members of this society is for direct sale, and cows calve at all seasons.

Recording was continued during the whole year. The recorder visited each farm at intervals of 28 days.

Of the 719 cows and heifers tested by this society, 197 cows and 84 heifers were included in Class I., and 43 cows and 28 heifers in Class III. Thus, of the total cows and heifers tested, 39 per cent were placed in Class I. and 10 per cent in Class III., compared with 32 per cent and 9 per cent respectively in 1914.

Kintyre and Islay Milk Record Society.

From 1912 to 1914 inclusive Kintyre and Islay each had their own milk recording society conducting 21 days tests, but owing to the resignation of members in both districts at the end of 1914, on the ground of expense, it was resolved to amalgamate the two societies in 1915 and form one joint 28 days society. The number of members in the joint society in 1915 was 24, the full membership of the society. The number of cows tested was 951.

In Kintyre and Islay there is a very limited market for sweet milk, and practically the whole of the surplus milk produced is made into cheese. Most of the cows calve in the spring months.

The records dated from 3rd February and covered a period of 42 weeks. The recorder visited each farm at intervals of 28 days.

Of the 951 cows and heifers tested by this society, 141 cows and 57 heifers were included in Class I., and 70 cows and 32 heifers in Class III. Thus, of the total cows and heifers tested, 21 per cent were placed in Class I. and 11 per cent in Class III.; an improvement of 2 per cent and 5 per cent respectively compared with the average results of the two separate societies in 1914.

Kirkcolm and District Milk Record Society.

This society was in its second year. The number of members was 15, an increase of 2 from the previous year, and three of the members had very large herds requiring two days' testing on each visit. The number of cows tested was 951, an increase of 118 from 1914, and a large number for a society conducting 21 days tests.

In practically all the dairying districts of Wigtownshire the bulk of the milk produced is made into cheese, and most of the cows calve in the early spring.

The records covered practically the whole year. The recorder visited each farm at intervals of 21 days.

Of the 951 cows and heifers tested by this society, 249 cows and 86 heifers were included in Class I., and 57 cows and 2 heifers in Class III. Thus, of the total cows and heifers tested, 35 per cent were placed in Class I. and 6 per cent in Class III.; a substantial improvement of 10 per cent and 5 per cent respectively from 1914.

Kirkcolm and Leswalt Milk Record Society.

This society was instituted in 1908, and was in its eighth year, though systematic milk recording was commenced in practically the same district in 1906 by the Rhins of Galloway Dairy Association. The number of members of the society in 1915 was 17, the same number as in previous years. The number of cows tested was 947, a large number for a society conducting 21 days tests.

The district is entirely a cheese-making one, and most of the cows calve in the early spring.

The records dated from 1st January, and covered the whole year with the exception of ten days at the end of December, when very few cows were in milk. The recorder visited each farm at intervals of 21 days.

Of the 947 cows and heifers tested by this society, 424 cows and 103 heifers were included in Class I., and 17 cows and 1 heifer in Class III. Thus, of the total cows and heifers tested, 56 per cent were placed in Class I. and 2 per cent in Class III.; an improvement of no less than 26 per cent and 6 per cent respectively from 1914.

Kirkmaiden and Stoneykirk Milk Record Society.

This society was in its fourth year. In 1914, in order to accommodate a number of new applicants, the district was divided. Two societies, each conducting 21 days tests, were obtained instead of one society conducting 28 days tests. But

owing to the withdrawal of a number of members at the end of 1914 it was decided to revert to the former arrangement of one larger society. The objection to the scheme of recording by some of the members whose herds were exceptionally large was the necessity of accommodating the recorder for two days on each round. In order to meet such objection it was arranged that in the cases of very large herds, where desired, the recorder should merely weigh the milk, test the samples, enter the particulars in the byre sheets, and post the byre sheets to the superintendent's office, where the sheets would be completed and the record books entered up, the local society paying the cost of the clerical work according to the time required. Five of the members took advantage of this arrangement, and the charge made for the clerical work in the office, including postage, amounted to no more than 23s. per herd. Thus a considerable saving was effected, while the recorder was able to do all the work required by these large herds in one day on each round. The total number of members in 1915 was 19. The number of cows tested was 1465, the largest number tested by one society in 1915.

The district is entirely a cheese-making one, and practically all the cows calve during the early spring months.

The records dated from the beginning of January and extended to 16th November, a period of 46 weeks, most of the cows being dry at this date. The recorder visited each farm at intervals of 27 days.

Of the 1465 cows and heifers tested by this society, 449 cows and 97 heifers were included in Class I., and 44 cows and 6 heifers in Class III. Thus, of the total cows and heifers tested, 37 per cent were placed in Class I. and 3 per cent in Class III.; an improvement of no less than 18 per cent and 8 per cent respectively compared with the average results of the two societies in 1914.

Lesmahagow Milk Record Society.

This society was inaugurated in 1907, and was in its ninth year. The number of members in 1915 was 28, the same number as in the two previous years. The number of cows tested was 694, an increase of 28 from 1914.

The district is chiefly a milk-selling one, and on most of the farms cows calve at all seasons, but in a few cases cheese is made, and the majority of the cows calve in the spring months.

Recording was continued during the whole year. The recorder visited each farm at intervals of 28 days.

Of the 694 cows and heifers tested by this society, 241 cows and 117 heifers were included in Class I., and 30 cows and

11 heifers in Class III. Thus, of the total cows and heifers tested, 52 per cent were placed in Class I. and 6 per cent in Class III., compared with 53 per cent and 8 per cent respectively in 1914.

Lower Wigtownshire (Newton Stewart District) Milk Record Society.

This society was in its third year. The members were situated chiefly in the Newton Stewart, Wigtown, and Kirkcowan districts. The number of members in 1915 was 13, a decrease of 1 from the previous year. Two of the herds required two days' testing on each visit. The number of cows tested was 610, a decrease of 89 from 1914.

The district is almost entirely a cheese-making one, and most of the cows calve during the early spring months.

The records dated from 5th January, and covered the whole year with the exception of four weeks in December, when very few cows were in milk. The recorder visited each farm at intervals of 17 days.

Of the 610 cows and heifers tested by this society, 190 cows and 56 heifers were included in Class I., and 22 cows but no heifers in Class III. Thus, of the total cows and heifers tested, 40 per cent were placed in Class I. and 4 per cent in Class III.; an improvement of 12 per cent and 8 per cent respectively from 1914.

Lower Wigtownshire (Whithorn District) Milk Record Society.

This, the parent Lower Wigtownshire Society, was inaugurated in 1907, and was in its ninth year. Most of the members were situated in the Whithorn district of Wigtownshire. The number of members in 1915 was 15, the same number as in the previous year. One of the herds required two days' testing on each visit. The number of cows tested was 826, an increase of 36 from 1914.

The district is a cheese-making one, and the great majority of the cows calve in the early spring months.

The records dated from 3rd January, and covered the whole year with the exception of four weeks in December, when very few cows were in milk. The recorder visited each farm at intervals of 19 days.

Of the 826 cows and heifers tested by this society, 311 cows and 76 heifers were included in Class I., and 28 cows and 7 heifers in Class III. Thus, of the total cows and heifers tested, 47 per cent were placed in Class I. and 4 per cent in Class III., compared with 52 per cent and 3 per cent respectively in 1914.

Mauchline Milk Record Society.

This society was in its fifth year. The number of members was 17, the full membership for a society conducting 20 days tests. The number of cows tested was 643, practically the same number as in 1914.

Most of the members of this society make cheese during the summer months, and sell milk during late autumn, winter, and early spring. On some of the farms milk is sold during the whole year. Most of the cows calve in spring, but a certain proportion calve in autumn or winter.

Recording was continued during the whole year. The recorder visited each farm at intervals of 20 days.

Of the 643 cows and heifers tested by the society, 341 cows and 106 heifers were included in Class I., and 10 cows and 7 heifers in Class III. Thus, of the total cows and heifers tested, 70 per cent were placed in Class I. and 3 per cent in Class III., compared with 69 per cent and 2 per cent respectively in 1914.

Monkton and District Milk Record Society.

This society was in its third year. The society was formerly known as "The Central Ayrshire No. 3 Milk Record Society," but at the beginning of 1915 the members decided to change the name of the society so as to give a clearer indication of the locality in which the society operated. The members were situated chiefly in the Monkton, Tarbolton, Symington, and Craigie districts. The number of members in 1915 was 13, a decrease of five from the previous year. The smaller membership was mainly due to the fact that most of the retiring members in 1914 failed to give definite intimation of their resignation in time to enable the society to obtain new members to take their places for 1915. The society have since adopted a rule that "Resignation of a member shall take effect at the end of the calendar year, and then only if the member has intimated his resignation in writing to the secretary of the local society before the date of the annual general meeting." The society obtained a full membership for 1916. The number of cows tested in 1915 was 598, a decrease of 110 from the previous year.

On some of the farms in this district milk is sold all the year round, and on other farms cheese is made during the greater part of the summer. Cows calve at all seasons, but the greater proportion calve in spring.

Recording was continued during the whole year. The recorder visited each farm at intervals of 21 days.

Of the 598 cows and heifers tested by this society, 154 cows and 58 heifers were included in Class I., and 61 cows and 17 heifers in Class III. Thus, of the total cows and heifers tested, 35 per cent were placed in Class I. and 13 per cent in Class III.; an improvement of 3 per cent and 4 per cent respectively from 1914.

Montgomerie Milk Record Society.

(Irvine and Dundonald Districts.)

This society was in its fifth year. The members were situated chiefly in the Irvine, Dundonald, and Crosshouse districts of Ayrshire. The number of members in 1915 was 25, an increase of one from the previous year, and one more than the full membership of the society. This was one of the two societies with the largest membership in 1915. The number of cows tested was 857, an increase of 88 from the previous year.

Most of the members of this society sell milk all the year round; their cows calve at all periods of the year.

Recording was carried on throughout the whole year. The recorder visited each farm at intervals of 28 days.

Of the 857 cows and heifers tested by this society, 407 cows and 174 heifers were included in Class I.; and 25 cows and 4 heifers in Class III. Thus, of the total cows and heifers tested, 68 per cent were placed in Class I. and 3 per cent in Class III., compared with 60 per cent and 3 per cent respectively in 1914.

Nithsdale Milk Record Society.

The members of this society were situated chiefly in the Sanquhar and Thornhill districts of Dumfriesshire. It is one of the oldest milk record societies in Scotland. The Nithsdale dairy farmers commenced milk recording in 1903, the year of the introduction of systematic milk recording into Scotland, but ceased recording for the next two years. The present society was formed in 1906, and was in its tenth year. The number of members in 1915 was 23, the full membership of the society. Several other farmers in the district desired to commence milk recording, and were included in the new Dumfries and District Society. The number of cows tested was 1001, an increase of 31 from the previous year.

Most of the members of this society make cheese during the summer months, and some of the farmers send milk to

town in autumn and winter. The majority of the cows calve in the spring months.

Recording was carried on throughout the whole year. The recorder visited each farm at intervals of 27 days.

Of the 1001 cows and heifers tested by this society, 411 cows and 143 heifers were included in Class I., and 37 cows and 5 heifers in Class III. Thus, of the total cows and heifers tested, 55 per cent were placed in Class I. and 4 per cent in Class III.; an improvement of 5 per cent and 4 per cent respectively from 1914.

The North of Scotland Milk Record Society.

This society was in its first year. The members were very widely scattered from Arbroath in Forfarshire to Maud in Aberdeenshire. The number of members was 5, the majority being breeders of British Holstein-Friesian cows. The number of cows tested was 206. All the members of this society produce milk for direct sale, and their cows calve at all seasons.

A considerable time elapsed at the beginning of the year before all necessary arrangements could be made; but recording was commenced on 16th April, the records dating from 17th March, and recording was continued during the whole year. The recorder visited each farm at intervals of 28 days. Many of the records were necessarily incomplete at the end of the first year, and the proportion of cows eligible for Class I. was less on this account than it would otherwise have been. Of the 206 cows and heifers tested, 19 cows and 3 heifers were included in Class I., and 18 cows but no heifers in Class III.

Ochiltree Milk Record Society.

This society was in its fourth year. The number of members in 1915 was 18, the full membership of the society. The number of cows tested was 476.

Most of the members in this district make cheese during the summer, and on some farms milk is sold in autumn and winter. The greater proportion of the cows calve in spring.

Recording was carried on throughout the whole year. The recorder visited each farm at intervals of 20 days.

Of the 476 cows and heifers tested by this society, 247 cows and 87 heifers were included in Class I., and 7 cows but no heifers in Class III. Thus, of the total cows and heifers tested, 70 per cent were placed in Class I. and 1 per cent in Class III., compared with 69 per cent and less than 1 per cent respectively in 1914.

Renfrewshire (Lower Ward) and Bute Milk Record Society.

This society was in its seventh year. The members were situated in the Kilmacolm, Greenock, and Inverkip districts of Renfrewshire, and in the Toward and Rothesay districts. The number of members in 1915 was 17, an increase of 1 from the previous year. The number of cows tested was 466, an increase of 53 from 1914.

Most of the members of this society produce milk for direct sale, and their cows calve at all seasons.

Recording was continued during the whole year. The recorder visited each farm at intervals of 21 days.

Of the 466 cows and heifers tested by this society, 167 cows and 43 heifers were included in Class I., and 32 cows and 2 heifers in Class III. Thus, of the total cows and heifers tested, 45 per cent were placed in Class I. and 7 per cent in Class III.

Renfrewshire (Upper Ward) Milk Record Society.

This society was in its fifth year. The number of members in 1915 was 16, the same number as in the previous year. The number of cows tested was 695, practically the same number as in 1914.

The members of this society produce milk for direct sale, and their cows calve at all seasons.

Recording was continued during the whole year. The recorder visited each farm at intervals of 20 days.

Of the 695 cows and heifers tested by this society, 205 cows and 95 heifers were included in Class I., and 25 cows and 14 heifers in Class III. Thus, of the total cows and heifers tested, 43 per cent were placed in Class I. and 6 per cent in Class III., compared with 45 per cent and 5 per cent respectively in 1914.

Stewarton and Dunlop Milk Record Society.

This society was in its second year. The members were situated throughout the wide and important dairying districts of Lugton, Dunlop, Stewarton, Kilwinning, Beith, Montgreenan, and Kilmaurs. The number of members in 1915 was 23. The number of cows tested was 886, practically the same number as in 1914.

In the districts of this society all the usual systems of dairying are carried on. On most of the farms milk is sold all the year round; on some butter is made; and on others the surplus

milk is made into cheese during the summer months. Cows calve at all periods of the year.

Recording was carried on throughout the whole year. The recorder visited each farm at intervals of 28 days.

Of the 886 cows and heifers tested by this society, 308 cows and 74 heifers were included in Class I., and 62 cows and 6 heifers in Class III. Thus, of the total cows and heifers tested, 43 per cent were placed in Class I. and 8 per cent in Class III., compared with 38 per cent and 8 per cent respectively in 1914.

The Stewartry Milk Record Society.

As in former years, the whole of the milk recording in the Stewartry of Kirkcudbright was carried on under the direction of one County Milk Record Society. This system offers several advantages. All overlapping of circuits is avoided. There is no difficulty in accommodating all new applicants at the beginning of each year, no matter from which districts the applications come. Where an ordinary local society at the end of the year falls temporarily short of full membership the existence of the society is threatened, owing to the expense becoming proportionately greater for the remaining members; but in the case of a large county society employing several recorders, new members at a considerable distance, or even at the other end of the county, may take the places of retiring members, and all members pay on the same basis.

The Stewartry Milk Record Society was formed in 1906, and in 1915 the society was in its tenth year. The total number of members was 60, the same number as in the previous year. The total number of cows tested was 3437.

In 1914 the Stewartry Society employed four recorders, but the society arranged for each of their recorders to test a larger number of cows, so that in 1915 three recorders tested the same number of herds as four recorders in the previous year.

Circuit No. 1.

(New Abbey, Kirkbean, and Dalbeattie Districts.)

The number of members on this circuit was 20. They were situated in the eastern portion of the county, mainly in the New Abbey, Kirkbean, and Dalbeattie districts. The number of cows tested was 1177.

Most of the dairy farms in the Stewartry are cheese-making farms, and practically all the cows calve in the early spring months.

Recording was continued throughout the whole year. The recorder visited each farm at intervals of 26 days.

Of the 1177 cows and heifers tested on this circuit, 385 cows and 185 heifers were included in Class I., and 78 cows and 9 heifers in Class III. Thus, of the total cows and heifers tested, 48 per cent were placed in Class I. and 7 per cent in Class III.; an improvement of 20 per cent and 5 per cent respectively, compared with the average results of Circuits 1 and 2 in 1914.

Circuit No. 2.

(Castle-Douglas District.)

The number of members on this circuit was 21. The members were situated chiefly in the Castle-Douglas district, and towards Auchencairn, Dundrennan, and Kirkcudbright. The number of cows tested was 1131.

The district is almost entirely a cheese-making one, and practically all the cows calve in the early spring.

Recording was carried on throughout the whole year. The recorder visited each farm at intervals of 26 days.

Of the 1131 cows and heifers tested on this circuit, 307 cows and 162 heifers were included in Class I., and 66 cows and 9 heifers in Class III. Thus, of the total cows and heifers tested, 41 per cent were placed in Class I. and 7 per cent in Class III.; an improvement of 11 per cent and 5 per cent respectively, compared with the average results of Circuits 2 and 3 in 1914.

Circuit No. 3.

(Kirkcudbright and Borge Districts.)

The number of members on this circuit was 19. The members were situated chiefly in the Kirkcudbright and Borge districts. The number of cows tested was 1129.

Most of the farms on this circuit are cheese-making farms, and practically all the cows calve in the early months of the year.

Recording was carried on throughout the whole year. The recorder visited each farm at intervals of 24 days.

Of the 1129 cows and heifers tested on this circuit, 267 cows and 124 heifers were included in Class I., and 111 cows and 10 heifers in Class III. Thus, of the total cows and heifers tested, 35 per cent were placed in Class I. and 11 per cent in Class III.; an improvement of 6 per cent and 4 per cent respectively, compared with the average results of Circuits 3 and 4 in 1914.

Strathendrick, Kirkintilloch, and District Milk Record Society.

Previous to 1915 the Strathendrick district and the Kirkintilloch district each had their own separate society, but owing to resignation of members in both districts it was resolved to amalgamate the two societies. The majority of the retiring members were milk-selling farmers who did not breed and rear their own stock to any extent, and were consequently not so deeply interested in their milk records. The number of members of the reconstituted society in 1915 was 17, and the members were widely scattered from Drymen in the west to near Bathgate in the east. The number of cows tested was 464.

Practically all the milk produced by the members of this society is for direct sale, and cows calve at all seasons.

Recording was carried on throughout the whole year. The recorder visited each farm at intervals of 21 days.

Of the 464 cows and heifers tested by this society, 161 cows and 46 heifers were included in Class I., and 22 cows and 6 heifers in Class III. Thus, of the total cows and heifers tested, 45 per cent were placed in Class I. and 6 per cent in Class III.; an improvement of 11 per cent and 5 per cent respectively, compared with the average results of the two societies in 1914.

GENERAL REVIEW.

Milk recording in Scotland fully maintained its position in 1915 in spite of the many disturbing influences due to the war. The Development Commissioners decided to continue their annual grant to The Scottish Milk Records Association in a year calling for national economy, and when many other development schemes were being strictly curtailed. An increased home production of food with a decrease in imports was considered of urgent importance, and the main object of the Association has always been to encourage and assist dairy farmers to increase the milk yields of their herds by systematic selection and skilful breeding.

The milk records of the Association have furnished abundant evidence that a good milking cow produces far more milk for food consumed and for the same general expenditure than a poor milking cow; that there are in the herds of this country at present a large number of cows which do not return the value of the outlays expended upon them, and that the great majority of herds are readily capable of considerable and rapid improvement in milk production.

Already many farmers, as a result of a comparatively short term of recording, have received a financial return out of all

proportion to the monetary outlay required under the scheme of the Association, which is generally not more than from 1s. to 2s. per cow, according to the age of the society, the number of members in the society, and the number of cows tested. An average increase in milk yield of over a hundred gallons per cow per annum has been effected in many instances, in addition to a substantial increase in the selling value of the stock, simply by taking advantage of the Association's scheme, and at the same time giving intelligent attention to selection, breeding, and feeding on the lines suggested by the milk records. A few instances of substantial improvement in milk yields, taken almost at random, are given later in this report. What has already been done by the smaller number of dairy farmers could easily be accomplished by others; and if we apply the same rate of improvement to all dairy herds in Scotland, we obtain some idea of the enormous latent possibilities in the national scheme of milk recording.

The Association's sphere of operations in 1915 extended to practically all the dairy cattle-breeding districts of Scotland, including the northern districts of Aberdeen and Inverness, so that any dairy farmer who desired to join in the movement had only to apply to the existing society in his own district. Generally speaking, where a local society cannot take in all applicants a new society is formed in the neighbourhood, or within a practicable distance. What is now required is a more general effort by the rank and file of dairy farmers, particularly by those who breed and rear dairy stock. By taking the utmost advantage of the scheme available they would materially enhance the national importance of the dairying industry in Scotland.

Though the number of herds tested in 1915 was very large, it comprised only a small percentage of the dairy herds of Scotland. The movement to eliminate the poor milking type of dairy cow, which is still all too prevalent, has not yet been seriously taken up by the majority of Scottish dairy farmers, and it must be admitted that, in spite of the relatively small monetary outlay entailed, the annual subscription is still the main obstacle in the way of very many farmers taking up milk recording, or to new members continuing.

Other reasons put forward were the trouble of accommodating the recorder, and the time required for conveying the recorder and the apparatus to the next farm. The solution of the difficulty connected with the transporting of the recorder and the apparatus round the circuit has been found in local societies owning a small pony and trap for this purpose, and it is satisfactory to find that the majority of local societies have

now taken this step. By this method all the members of a society bear the cost equally, so that the member who happens to be situated farther from the member next in the circuit does not have to bear more of this burden than his nearest neighbour.

A more candid reason than that of expense in a number of cases would have been the rather disappointing milk yields of the herds when represented in definite figures and compared with the records of other herds in the same district. Farmers in not a few cases were evidently rather ashamed of their herds' performance, and under one plea or another decided to seek obscurity for a few years, probably to improve matters, overlooking the fact that a good improvement may be even more creditable than a good yield.

A plea made by a number of farmers who discontinued their membership was that their farms lay too high, or were too poor, to enable their cows to compete successfully with other herds. They failed to recognise that the main object was not a competition between farms, and that the variations in their cows' yields were quite as marked as on good farms. It has been found that even on poor land some of the cows give about double the amount of produce of other cows, and many instances could be given where on inferior soil, by care in selection and breeding, a useful improvement has been effected as easily as on good soil. Further, a cow on a poor farm is not required to give quite as good a yield. It is widely recognised that a type of cow which will give a moderately good yield of milk on poor land is likely to prove a capital milker on good land.

Some farmers maintained that after a few years of milk recording their herds' milk yields were no better than before. On inquiring into such cases one generally found that the farmer had neglected to ascertain the hereditary milking qualities on the bull's side, and had persisted in the use of sires of poor-milking strains, thus losing in one direction all that he could hope to gain in the other.

With regard to the matter of expense already referred to, the difficulty lay entirely in getting some farmers to realise fully the advantages that would accrue to them from a little outlay in money and a little trouble and perseverance applied towards the improvement of their herds. They preferred to work on the principle that "a bird in the hand is worth two in the bush," a very bad principle in farming. Fortunately for every one who has given up milk recording after a brief trial, there are many who have adopted it as a regular and indispensable part of the ordinary routine of dairy management, and from the

number that have already gained marked advantage from milk recording, it may be taken for granted that where any farmer has failed to benefit after a few years of recording under the Association's scheme, the reason is to be found in the fact that he has been running his herd on wrong lines. And yet, in this case also, milk recording must be credited with having served a useful purpose in pointing out this fact and suggesting a change of method.

In the report of last year was given a brief account of the improvement effected in over a hundred herds in five years. It was shown that the number of cows eligible for Class I. had been doubled in these herds in that time. A considerable further advance has to be noted in 1915, in spite of the fact that in many districts in Scotland the weather in the early part of the summer was much too dry for milk production. In 1914, of a total of 26,424 cows tested, slightly less than 40 per cent were eligible for Class I. In 1915, of the 26,572 cows tested, over 46 per cent were included in Class I., a good improvement from 1914. Again, in 1914 almost 9 per cent of the cows tested failed to qualify for Class II., while in 1915 less than 6 per cent failed to qualify for Class II.

Below are given three instances of the improvement effected in well-regulated herds in the last six years. These cases are taken almost at random from the Association's Annual Reports, and numerous other instances of a like nature could be noted by any one possessing a clue to the identity of the herds from year to year.

The following short table shows the improvement in one herd in the Fenwick district from six years' continuous recording:—

HERD.		Year.	Number of Cows tested.	Percentage of Cows in Class I.
Society.	Farm letter in Annual Report.			
Fenwick . .	O	1910	46	39
Fenwick . .	M	1911	42	64
Fenwick . .	W	1912	50	58
Fenwick (High) .	O	1913	52	77
Fenwick (High) .	Q	1914	48	88
Fenwick (High) .	...	1915	53	80

The following table shows in a similar way the improvement in one herd in the Mauchline district from six years' continuous recording:—

HERD.		Year.	Number of Cows tested.	Percentage of Cows in Class I.
Society.	Farm letter in Annual Report.			
Cumnock . .	F	1910	48	40
Mauchline . .	E	1911	52	56
Mauchline . .	B	1912	55	55
Mauchline . .	G	1913	56	79
Mauchline . .	D	1914	60	83
Mauchline . .	...	1915	53	82

The following table shows in a similar way the improvement in one herd in the Carrick district:—

HERD.		Year.	Number of Cows tested.	Percentage of Cows in Class I.
Society.	Farm letter in Annual Report.			
Carrick . . .	B	1910	43	49
Carrick . . .	H	1911	39	54
Carrick . . .	L	1912	44	61
Carrick . . .	J	1913	38	89
Carrick . . .	G	1914	43	93
Carrick . . .	...	1915	39	97

The point should not be overlooked that with the same number of cows in the herd one cow more raised to Class I. would, on the average, represent an additional 240 gallons of milk of 3·5 per cent fat annually, worth about £8, or quite twice the amount of the annual subscription of members of local milk record societies.

Unfortunately, the abnormal conditions prevailing at the

beginning of 1915, owing to the continuance of the war, became aggravated during the year, and considerable difficulties on this account were experienced. One of the first effects was a scarcity of recorders due to enlistment. Before the end of 1915 no fewer than twenty-four recorders or members of the central staff had left to join the army or to engage in munition work ; while the number of new appointments of central staff and recorders from the beginning of August 1914 up to the end of November 1915 was forty-two.

Previous to the war all the recorders were young men, but in December 1914 the Executive Committee agreed to approve of the appointment of qualified women-recorders. A number of applications from qualified young women were received, and seven women-recorders were employed in 1915.

Formerly all the Gerber milk-testing apparatus used by local societies was manufactured in Germany or Austria, so that the war had the effect of cutting off the Association's supplies in these articles. The Committee were ultimately able to purchase supplies from new makers at slightly increased prices.

In May 1915 the larger part of the output of sulphuric acid in this country was requisitioned for military purposes, but a sufficient supply was obtained for the Association's requirements. With regard to the supply of amylic alcohol, during the year this article increased in price from 1s. 8d. to 2s. 6d. per lb. However, a cheaper quality of amylic alcohol was tested, and was found to give equally accurate results, and the Committee were able to purchase a supply of this article at 1s. 5d. per lb.

The Association are in a position to report that, in spite of exceptional difficulties and distractions due to the war and extensive dislocations of the dairying and other industries, milk recording in Scotland was never carried on more extensively or with greater precision than in 1915 ; and it is very creditable to the dairy farmers concerned that the milk records of 1915 compare so favourably with those of former years.

Special difficulties which dairy farmers had to contend with during the year were a scarcity of labour and of concentrated cattle foods, and a threatened scarcity of artificial manures. For these reasons chiefly some farmers took the view that milk recording might be discontinued in 1916 or during the period of the war. This of course implied that a diminished production of milk was contemplated. The question was discussed at a meeting of the Executive Committee, and the Committee unanimously agreed that the state of affairs did not warrant suspension of the Association's activities. Attention was directed to the report of the Scottish Departmental Committee on Food Production, and to

the efforts of the Board of Agriculture for Scotland in trying to impress upon farmers the necessity of increasing home production in 1916. It was pointed out that the breeding of dairy cattle and the production of dairy produce were the main items of farming in the south-west of Scotland; that, through the efforts of the Association, the milk yields of cows had already been considerably increased, and that it was most undesirable that local societies should suspend or relax their efforts in that direction. The great majority of local societies ultimately decided to continue recording in 1916.

ANALYSES FOR MEMBERS DURING 1915.

By DR J. F. TOCHER, Aberdeen, Analyst to the Society.

THE number of samples submitted for analyses during the year 1915 was 141. The following table shows the numbers and nature of the samples analysed during the last eight years:—

	1915.	1914.	1913.	1912.	1911.	1910.	1909.	1908.
Fertilisers . . .	36	48	46	58	68	61	97	68
Feeding-stuffs . .	28	28	25	28	23	30	26	28
Waters	26	44	27	15	17	26	16	29
Miscellaneous . .	51	22	19	21	18	29	20	10
	141	142	117	122	126	146	159	135

FERTILISERS.

General.—The fertilisers submitted for analysis during the year included all the well-known varieties, such as samples of Peruvian guano, Thomas phosphate powder, chloride of potash, sulphate of ammonia, superphosphate, slag-dust, nitrolim, bone-meal, and ground lime. A sample of sewage sludge was analysed, and was found to have the following composition in the wet state: nitrogen 0·573 per cent, insoluble phosphate of lime 0·539 per cent, potash 0·067 per cent. When completely dried the sludge contained nitrogen 1·82 per cent, insoluble phosphate 1·71 per cent, potash ·213 per cent. The dried sludge would thus have a manurial value if purchased at a suitable price. Most of these fertilisers were normal in condition, and, with one or two exceptions, contained the proportion of constituents guaranteed. A sample of nitrolim guaranteed to contain 18 per cent of nitrogen was found to contain only 14·72 per cent. A sample of slag-dust guaranteed to contain 22 per cent insoluble phosphate gave only 18·23 per cent of total phosphates, of which 15·34 per cent was citric soluble. The potato manures examined were found to contain less proportion of potash than formerly. The proportion of potash varied from 0·27 per cent to 3·89 per cent. The average proportion of potash was found to be 2·12 per cent for this year, as against 4·09 per cent for 1914. A sample of basic slag was analysed and was found to contain 27·92 per cent of citric soluble phosphate. The sellers guaranteed the slag to contain 37 per cent citric soluble phosphate. They have admitted the

mistake they made in giving the guarantee, and they have intimated their willingness to make the proper reduction.

The following table shows the composition of a few of the mixed fertilisers examined;—

TABLE I.
MIXED FERTILISERS.

Name of Fertiliser.	Nitrogen.	Soluble Phosphate.	Insoluble Phosphate.	Potash.
1. ...	0.54	21.98	7.84	0.84
2. Potato	8.43	9.58	11.37	2.61
3. ...	5.27	17.81	5.79	3.89
4. Potassic fertiliser . . . .	...	5.07	14.96	3.49
5. Potato	6.93	21.52	3.18	2.43
6. Turnip	3.56	18.43	6.46	1.67
7. ...	1.73	32.69	8.95	0.27
8. ...	2.38	...	32.97	...

Supply of Potash.—In my last year's report I made some reference to the scarcity of potash, and conducted inquiries as to the possibility of producing potash salts or a suitable potash fertiliser from minerals containing orthoclase felspar, from seaweed, and from other sources. Since then a pamphlet has been issued by the Imperial Institute which reviews the world's supply of potash. All the more important sources of potash in the world were noticed in this pamphlet, and in particular the enormous deposits of potash salts recently found in the salt district of Cardona in Catalonia, Spain. The deposits have been prospected, chiefly near the town of Suria to the south-east of Cardona, where extensive borings have been made. The results obtained have been described in a pamphlet issued by the Geological Institute of Spain, where full details can be obtained. About 220 yards from the town of Cardona, beds were found which contained potassium chloride to the extent of 97 per cent. The Spanish Government has reserved temporarily the right to the lands in the provinces of Barcelona and Lerida, which have been investigated by the Geological Institute. The Spanish potash deposits are not quite so regular as those of Stassfurt, but it must be borne in mind that the borings in Spain have up to now been carried to only a sixth of the depth of those in Germany. It is clear from the report that these deposits are of very great value. When the concession is in full working order Spain bids fair to rival Stassfurt in the supply of potash minerals to the world.

FEEDING-STUFFS.

Ground-Nut Cake.—Of the 28 feeding-stuffs examined, two were samples of earth-nut or ground-nut cake, and were found to contain 26 per cent of fibre, which is about the average for undecorticated earth-nut cake. The decorticated cake contains about 5 per cent of fibre. In one of these a comparison with linseed-cake was required. The proportions of oil and albuminoids were similar to those of a linseed-cake of good quality, but the amount of indigestible matter in the form of fibre was about three times greater than the average proportion found in linseed-cake. The amount of soluble carbohydrates in the ground-nut cake was correspondingly less. Ground-nut (*Arachis hypogaea*), and called, variously, earth-nut, monkey-nut, and pea-nut, is now attracting the attention of agriculturists more than it did in pre-war times. The following table shows the composition of two samples of the undecorticated cake analysed for members during 1915. The averages of results of analyses of samples of the undecorticated cake, of the decorticated cake, and of linseed and cotton-seed cakes, are given alongside, in order that the different values may be compared.

TABLE II.

Name of Cake.	Oil.	Albuminoids.	Carbohydrates.	Fibre.	Ash.	Moisture.
Undecorticated ground-nut cake	8.61	31.69	18.93	26.62	4.84	9.34
Undecorticated ground-nut cake	7.48	33.75	18.22	26.60	5.17	8.78
Decorticated ground-nut cake	7.76	47.81	23.76	4.39	7.06	9.22
Linseed-cake	11.07	26.31	33.61	7.71	5.26	16.04
Cotton-seed cake, undecorticated	5.85	18.27	36.58	22.16	6.34	10.80
Cotton-seed cake, decorticated	7.74	39.12	25.84	10.05	5.23	12.04
Palm-nut meal	10.30	16.81	44.95	12.05	3.39	12.50

It has been shown experimentally that ground-nut cake is easily digestible, the results showing a higher value in digestibility than linseed and cotton-seed. Professor Hannson, the Swedish authority, places ground-nut cake at the top of the list, using the scale of milk units devised by him. France, Germany, Sweden, and Holland were the chief importers of ground-nut cake prior to 1914. The supply to Germany is

now off, and considerable quantities are now being used in this country. There are various grades of quality, the grade known as Rufisque, made largely in France, being the best.

Cotton-Cake.—A sample of cotton-cake was said to have been the cause of the death of a number of calves, and was therefore analysed for metallic and other poisons, and also for dangerous micro-organisms. The sample was found to be perfectly normal in every way, and it therefore seemed likely that this was a case of fatal sickness among calves due to the cotton-cake feed. Several cases of deaths have been reported as the result of feeding pigs and calves with cotton-cake and cotton-meal. In a former report I pointed out the danger arising from indiscriminate use of cotton-seed cake, especially as a food for calves. In this connection it seems desirable to draw the attention of agriculturists to the results of an important scientific investigation recently published in the 'American Journal of Agricultural Research.' In this Memoir it is proved that the poisonous action of cotton-seed is due to the presence of a small proportion of a toxic poison in cotton-seed kernels. This substance was named gossypol by the original discoverer, Marchlewski. Messrs Withers and Carruth show that the poisonous action of cotton-seed is due to this substance, and in their paper they consider various methods of rendering cotton-seed kernels non-toxic by the destruction of the active principle or by changing it to a physiologically inert form. It is fair to note that fatal results arising from the use of cotton-seed cake are very infrequent, and are entirely due to accident or to want of skill in feeding.

General.—Four compound cakes were examined, and all were found to contain a proportion of fibre distinctly above the average for cakes of this class. The proportion of fibre ranged from 11 per cent to 14·5 per cent. A mixed cake made from ingredients of good quality need not contain more than 10 per cent of fibre. A sample of River Plate bran contained a small quantity of an innocuous vegetable powder in a very fine state of division. This powder appears to have got into the nostrils and windpipes of horses being fed with the bran and to have brought about violent coughing. A sample of molasses meal was guaranteed to contain 75 per cent of pure treacle, and was found to contain 20·7 per cent of cane sugar and 27·2 per cent of invert sugar. A sample of Russian linseed-cake was found to contain an exceptionally high proportion of albuminoids—namely, 35·5 per cent. The proportion of albuminoids varies in linseed-cake from 26 to 30 per cent. Two samples of dried grain were found to be distinctly below the average in albuminoids. Another sample of dried grains was found to be 7

per cent deficient in the proportion of albuminoids guaranteed to be present. The guarantee was 20 per cent albuminoids; the proportion found was 13 per cent. A sample of dried grains was also submitted for analysis for the purpose of determining whether any poisonous substances were present in the sample. No poisons were found to be present, only a few polygonaceous seeds were detected in the sample.

MISCELLANEOUS SAMPLES.

Bowel Contents.—Several samples of bowel contents, portions of intestinal wall, and other material from horses were examined for poisons, and were also examined bacteriologically. No evidence of any metallic or toxic poisons was found to be present in any of the samples, and no pathogenic organisms were detected. These samples were analysed in order to determine whether the deaths occurring among horses from impaction of the colon or sub-acute obstruction of the colon were associated with any specific organism or any toxic poison. Veterinary surgeons and veterinary experts agree in attributing the cause or causes of sub-acute impaction of the colon to some error in the feeding of horses or to a sudden change in the manner of feeding, and not to the action of any micro-organism. Mr William Brown, Lecturer on Veterinary Hygiene, North of Scotland College of Agriculture, Aberdeen, to whom I applied for an expert opinion, informed me that the chief factors in producing impaction are: (1) too much food and too little exercise; (2) an insufficient supply of water; (3) a paralytic condition of the wall of the bowel; (4) hay badly cured or dry and fibrous; (5) inferior oats and new oats; and (6) a mixture of green grass and old dry grass. Indeed, too dry grass alone has been found sufficient to bring about the disease. Intestinal obstruction can generally be prevented if the advice given by veterinary surgeons is followed, but it seems almost impossible to cure impaction after it has commenced, owing to the set of conditions bringing about the impaction. The gist of the advice given by experts is to see that, at the period of changing of feeding, horses get (1) a sufficient supply of water; (2) a measured but sufficient supply of the new food; (3) water and food proportional to the amount of work done by each horse; (4) a gradual change, when a change becomes necessary, from one kind of feeding to another; (5) well-cured hay and oats of good quality when hay and oats form part of the food supply; and (6) avoidance of dry grass, especially in excess of cocksfoot heads or of ryegrass. While attending to the above expert advice, however, one must not lose sight of the effect of heredity—certain horses may inherit a flabby condition of

the bowel and may thus be predisposed to an attack of impaction. In view of the frequent examination of bowel contents of horses, always with negative results, I have considered it worth while to collate the above facts for the use of the members of the Society.

Waters.—Of the 26 samples of water examined, three were found to have a distinctly solvent action on copper and lead, while one sample was found to contain as much as 8 parts of lead per 100,000 parts of water. New sources of supply were secured, and the samples from these sources were found to be of good quality.

Milks.—Of the 28 samples of milk examined, three were found to be deficient in butter-fat and two were found to be distinctly below the average in solids not fat. One of the samples submitted for bacteriological analysis was found to contain excess numbers of a micro-organism which had brought about sliminess in the milk, rendering it unfit for use.

Insecticide.—A sample of insecticide when examined was found to contain 22·5 per cent of naphthalene mixed with insoluble mineral matter, chiefly clay.

THE CEREAL AND OTHER CROPS OF SCOTLAND FOR 1915, AND THE WEATHER OF SCOTLAND IN 1915.

THE CROPS.

THE following comparison of the cereal and other crops of 1915 with those of the previous year has been prepared by the Secretary of the Society from answers to queries sent to leading agriculturists in different parts of the country.

The queries issued by the Secretary were in the following terms:—

1. What was the quantity, per imperial acre, and quality of grain and straw, as compared with last year, of the following crops? The quantity of each crop to be stated in bushels. What quantity of seed is generally sown per acre?—(1) Wheat, (2) Barley, (3) Oats.
2. Did the harvest begin at the usual time, or did it begin before or after the usual time? and if so, how long?
3. What was the quantity, per imperial acre, and quality of the hay crop, as compared with last year, both as regards ryegrass and clover respectively? The quantity to be stated in tons and cwts.
4. Was the meadow-hay crop more or less productive than last year?
5. What was the yield of the potato crop, per imperial acre, as compared with last year? The quantity to be stated in tons and cwts. Was there any disease? and if so, to what extent, and when did it commence? Were any new varieties planted, and with what result?
6. What was the weight of the turnip crop, per imperial acre, and the quality, as compared with last year? The weight of the turnip crop to be stated in tons and cwts. How did the crop braird? Was more than one sowing required? and why?
7. Were the crops injured by insects? State the kinds of insects. Was the damage greater or less than usual?
8. Were the crops injured by weeds? State the kinds of weeds. Was the damage greater or less than usual?
9. Were the pastures during the season of average growth and quality with last year?
10. How did stock thrive on them?
11. Have cattle and sheep been free from disease?
12. What was the quality of the clip of wool, and was it over or under the average?

From the answers received, the following notes and statistics have been compiled:—

EDINBURGH DISTRICT.

MID-LOTHIAN. *Wheat*—40 bushels; crop not so good as last year; 3 bushels seed sown. *Barley*—40 bushels; 10 bushels less than last year; straw, an average crop; 3 bushels seed sown. *Oats*—44 bushels; straw about the same as last year. *Harvest* began a week later, and very broken weather. *Hay*—A very light crop, 1 ton 10 cwt. per acre, or a ton less than last year; a fine second crop, and well got; 2 tons per acre. *Meadow-hay*—None grown. *Potatoes*—Not so good as last year; late varieties, 6 tons per acre; small, and some disease. Price, fully £1 per ton more than last year. *Turnips*—Fine crop; about 20 tons per acre; braided well; no second sowing. *Mangold*—About 10 tons per acre less than last year. *Insects*—No damage by insects or by weeds. *Pastures*—Much the same as last year. *Live Stock* thrived well. Cattle and sheep free from disease. *Clip of wool* about the average.

WEST LOTHIAN. *Wheat* this year is disappointing as regards the quantity, say 5 qrs.; quality good, and straw nice and clean; seed sown, 4 bushels. *Barley* much the same as last year—about 44 bushels; a smaller acreage grown, hence the big price of 60s. per qr.; quality good; seed sown, 5 bushels. *Oats* thrashing well, say 48 bushels; quality good; seed sown—small oats, 4 bushels; thick oats, 5 to 6 bushels. *Harvest* began on early places end of August, but general in first week of September. The cereals did not ripen regularly, and with labour scarce harvest was protracted. *Hay* short and smaller in bulk; 30 to 35 cwt. *Meadow-hay*—Good. *Potatoes*—The yield of the potato crop is very bad, owing first to disease in the fields and then to potatoes not keeping in the pits; yield uncertain. Some of the newer tubers did well, and very clear of disease. *Turnips* a good crop all over, say 16 to 20 tons. Owing to the drought did not braird too well, and stood still after thinning for some time, but after the rain did well. In some places finger-and-toe was prevalent. *Insects*—None except in wheat after it was braided. *Weeds*—None. *Pasture* bare in beginning of season, but improved later on. *Live Stock* did not thrive till well on in the season. Cattle and sheep free from disease. *Clip of wool*—Good.

EAST LOTHIAN (Upper District). *Wheat*—42 bushels; quality only fair; quantity of straw above an average, and all secured in good order; seed sown, 4 bushels drilled. *Barley*—40 bushels per acre; about 15 bushels short of 1914 crop; quality not an average, and quantity of straw below an average; 3½ bushels sown per acre drilled. *Oats*—56 bushels per acre; the best crop for some years; quality of grain good, and quantity of straw considerably over an average. Seed varies from 4 bushels for potato oats to 5½ bushels for Records, Leaders, Waverleys, &c. *Harvest* generally was about ten days later than most years. *Hay*—About 1½ tons per acre; quality not an average, and about 15 cwt. short of 1914 crop. A proportion deteriorated by bad weather while being harvested. There is no *Meadow-hay* grown in this district. *Potatoes*—Crop about 7 tons; about 1½ tons short of 1914. Disease in some varieties, such as Dates, very bad—on an average about half diseased. Crop affected very early—third week in August. Arran Chief variety a good crop, and practically free from disease. *Turnips*—18 tons; crop above an average, but some districts badly affected by

"finger-and-toe." Crop braided well, and no second sowing. No injury by insects. Crops were not injured by weeds more than usual. *Pastures* were good, and did not suffer much from drought except for a short time in June. *Live Stock* thrived well. A few more cases of anthrax occurred during December than usual. *Clip of Wool*—About an average.

EAST LoTHIAN (Lower District). *Wheat*—44 bushels; quality good; fair bulk of straw, but yield disappointing; $3\frac{1}{2}$ bushels drilled, 4 bushels broadcast. *Barley*—40 to 48 bushels; yield less than last year owing to lack of sunshine when crop was ripening; quality only fair, under average; straw, fair bulk; seed sown, 3 bushels, drilled. *Oats*—48 bushels old varieties, and about 72 of the newer and coarser varieties; seed sown, 4 bushels of former and 5 or $5\frac{1}{2}$ of the latter. *Harvest* began about 20th August, or about a week later than average. *Hay*—First crop very light—1 to $1\frac{1}{2}$ tons; second crop a grand one, and rather heavier than the first. *Meadow-hay*—Not much grown. *Potatoes*—Up-to-Date varieties almost a complete failure; worst since 1872, so much disease; unsprayed crops were blighted by 15th August, sprayed crops attacked 25th September; yield, 2 tons to 5 tons per acre; Golden Wonder and What's Wanted, about 6 tons per acre; Arran Chief did well, and resisted disease; about 8 tons. *Turnips*—A good crop, 25 tons per acre; frosts in November did damage to quality; except on late pieces not much second sowing required, but where this was done the drought caught crop, and it suffered considerably. *Insects*—Diamond-back moth did damage in places. *Weeds*—Charlock in some places troublesome. *Pastures* under average owing to cold spring followed by drought, but rains in summer made growth plentiful later. *Live Stock* did well. Cattle and sheep free from disease. *Clip of wool* under average.

BORDER DISTRICT:

BERWICKSHIRE (Merse). *Wheat*—38 bushels; quality of both straw and grain above an average, but not so very superior as the previous year; straw abundant; seed, 4 bushels per acre. *Barley*—34 bushels; quality only fair for both grain and straw; strong demand and prices abnormally high; seed, 3 to $3\frac{1}{2}$ bushels. *Oats*—38 bushels—thick-skinned new varieties considerably more; grain and straw of good quality, except in later crops, where ripening was a little irregular; 4 to $4\frac{1}{2}$ bushels sown of old fine-skinned oats, and up to 6 and 7 bushels for some new varieties. *Harvest* was a week to a fortnight later than the usual time, and owing to irregular ripening was in some cases more protracted than usual. *Hay*—In the case of some of the moister and deeper class of soils, especially if unstocked in spring, a fair crop of hay was got; but in average conditions the hay crop was little over half an average crop, both ryegrass and clover being deficient; 20 to 28 cwt.—in some cases 30 to 35 cwt. Aftermath came away better, and second crop hay was unusually good. *Meadow-hay*—A very short crop, and much damaged by wet weather; about 20 to 23 cwt. *Potatoes*—About $6\frac{1}{2}$ tons; 30 to 50 per cent of the Up-to-Date varieties diseased; Arran Chief, King Edward, Golden Wonder, and some other newer varieties either entirely free from disease or only slightly affected; disease began about the beginning of the harvest-time and spread quickly. *Turnips*—In many cases crop braided badly, and owing to dry weather, frosty nights, and attacks of "turnip-fly," resowing even more than once was quite common. Later in the season there was a good growth of shaw, and but for a second drought in October and early frost in November the crop would

have been much better ; crops on an average, about 16 to 19 tons yellow turnips and about the same of swedes. *Insects*—Turnip-beetle (fly) was very destructive—the weather when turnips were brairding was very favourable for its propagation. *Weeds* were more prevalent than usual ; the weather was in favour of their growth and against getting them effectively destroyed ; labour to do the cleaning was very short. *Pastures* were abnormally bare nearly all the season ; only for a short time in August was there anything like the usual growth. *Live Stock*—Stock generally did well, but their feed was largely supplemented by bought-in feeding-stuffs. Cattle and sheep free from disease. *Clip of wool* about average.

BERWICKSHIRE (Lammermoor). *Wheat*—Comparatively little wheat is grown in this district. *Barley*—32 bushels ; only fair quality, and straw not more than an average either in quality or quantity ; seed, 3 to 3½ bushels. *Oats*—36 bushels ; crop generally yielding better than was expected, especially new and thick-skinned varieties ; grain of fair quality, some being rather unequally ripened ; straw good quality ; seed, 4 to 6 bushels, according to variety of seed. *Harvest*—About a fortnight behind the average date, and owing to slow and irregular ripening ; was a long one ; weather was good on the whole, but dewy mornings were very prevalent, and occasioned much delay. *Hay*—A very poor crop all over, both clover and ryegrass, and owing to showery weather the quality was very inferior ; 20 cwt. *Meadow-hay*—Poor crop, and generally inferior quality ; owing to very showery weather much of the crop was allowed to remain uncut till the quality was deteriorated ; under 20 cwt. *Potatoes*—7 tons ; disease very common—about 30 to 40 per cent in the commoner varieties, which are mostly grown. *Turnips* mostly brairded well, but many patches had to be resown—often more than once—frosty nights and attacks of “turnip-fly” being the cause. *Insects* rather worse than usual. *Weeds* were very difficult to keep down owing to a month of damp growing weather. *Pastures* never got rough all the season, and box-feeding was more commonly resorted to than usual. *Live Stock*—Stock were very short of grass during the early part of the season, and although it was more plentiful later, old and rotation pastures were bare all the season ; hill pastures were rather better. Cattle and sheep free from disease. *Clip of wool*—Average.

ROXBURGHSHIRE. *Wheat*—36 bushels ; full crop of straw of good quality ; 3 bushels seed per acre. *Barley*—32 bushels ; average crop of straw of good quality ; 2½ to 3 bushels per acre. *Oats*—From 36 to 80 bushels ; straw plentiful and of good quality. *Harvest* ten days later than an average. *Hay* crop 1½ tons per acre ; much destroyed by weather ; less than last year ; some second crop of better quality. *Meadow-hay*—Less productive ; 15 cwt. per acre. *Potatoes*—Smaller yield ; some disease previous to being lifted ; no new varieties grown to any extent. *Turnips* brairded slowly ; a good deal of resowing ; some finger-and-toe ; 17 tons per acre. *Insects* not more than usual. *Weeds*—A good many of the usual kinds ; unable to be cleaned owing to wet weather and also to shortage of labour. *Pastures*—A good average. *Live Stock* thrived well ; on the whole, no more than usual. *Clip of wool*—Slightly lighter than usual ; quality good.

SELKIRKSHIRE. *Wheat*—At least 40 bushels an acre, and fine quality. *Barley*—About 34 bushels. This crop has not thrashed satisfactorily ; the yield has not come up to the appearance. *Oats* were only a moderate crop in this county, but were secured in good order, and will thrash

36½ bushels. *Harvest* began at usual time. *Hay*—The hay crop was a very moderate one, and in many instances would not exceed 180 stones per acre; the quality was very deficient. *Meadow-hay*—This crop was neither the quantity nor the quality of last year, and would not exceed a ton per acre all over. *Potatoes* were quite a good crop; about 6 tons per acre, but in many cases there was a good deal of disease; no new varieties. *Turnips* are above an average crop, and of good quality. They braided well, and no resowing was required. No injury by insects or weeds. *Live Stock* thrived quite well. Cattle and sheep free from disease. *Clip of wool*—Quality good; quantity much less than last year.

PERKLESSHIRE. *Wheat*—None grown. *Barley*—36 bushels per acre; 1 ton straw; less than last year; fair quality; 4 bushels per acre sown. *Oats*—38 bushels per acre; 25 cwt. straw; similar to last year; 5 to 7 bushels sown. *Harvest* began at usual time; a good harvest. *Hay*—2 tons; much the same as last year; very much damaged by rain. *Meadow-hay*—3 tons; a good crop; also damaged by rain. *Potatoes*—7 tons; a few diseased; small in size, and not so good as last year; frosted early. *Turnips*—10 to 16 tons; very variable; not so good as last year; a little resowing. *Insects*—Some damage from fly on turnip. No injury by weeds. *Pastures*—Average growth and quality of last year. *Live Stock*—Sheep did well; cattle did not put on as much condition as usual. Cattle and sheep free from disease. *Clip of wool*—Full average.

DUMFRIES DISTRICT.

DUMFRIESHIRE (Annandale). *Wheat*—Very little grown. *Barley*—Straw below the average owing to dry summer; grain of average quantity, but slightly discoloured by a time of dull sunless weather before being stacked; yield, about 36 bushels; seed sown, 3½ to 4 bushels per acre. *Oats*—The seed was got in in good order, but the braird owing to dry weather made slow progress. A time of showery weather in the latter part of July and first of August saved the crop which at one time looked as if it was to be a failure. The result was a shortage of straw, which would barely reach last year's low average (18 cwt.); grain, however, was perhaps under the usual average. Excellent harvest weather secured good quality; yield 35 bushels per acre; seed sown, "Potato" and "Hamilton" 4 to 6 bushels; newer varieties 6 to 7 bushels; when drilled, one bushel less per acre. *Harvest* was general by the 23rd August, a few days before the usual time. *Hay*—Ryegrass hay a little over last year's average; increased weight made up by clover, which was more in evidence this year; quality generally good. *Meadow-hay* yield rather better than last year, but quality not so good. Showery weather prevailed during the harvesting of this crop, and the greater part was more or less damaged. *Potatoes*—This crop gave great promise during the summer, but disease made its appearance about the second week in August; a return to drier weather checked this, and the crop did not suffer to any great extent; yield, 7 to 8 tons per acre. *Turnips*—A good crop; much better than last year; average yield, 26 to 28 tons per acre. Notwithstanding the dry weather the plants came quickly to the hoe; in very few cases was resowing needed. Unfortunately a severe frost set in on 15th November before the storing of the roots was finished; this continued well into December and did much damage. *Insects*—Crops were free from insect pests. *Weeds*—Owing to drought weeds were easily kept under during the early

summer, and consequently the damage was less than usual. *Pastures* suffered severely from drought during May, June, and July, but the showers in August gave them a start which was maintained throughout the remainder of the season. Quality would compare favourably with 1914—also a dry season. *Live Stock* thrived well, and came to the autumn sales in good condition. Cattle as a rule have been free from diseases of a serious nature. Minor troubles such as “hoose” and “ringworm” have been prevalent during the autumn and early winter. Flockmasters have had an extra good season as regards disease. Seldom have the losses from “braxy” been so few. *Clip of wool*—Full average, and of good quality.

DUMFRIESSHIRE (Nithsdale). *Wheat*—None grown. *Barley*—None grown. *Oats*—An average crop; 38 bushels; on dry land, with the long continued drought, the straw was very short; on heavy ground the crop was above average. *Harvest* began about the usual time. *Hay*—A small crop; would not average a ton per acre. *Meadow-hay*— $\frac{1}{2}$ less than last year, and badly got. *Potatoes*—5 tons per acre; disease was very prevalent after beginning of September. *Turnips*—Very variable; 18 tons; the braird was quite good, but between frost, fly, drought, and rooks many had to be sown over more than once. No injury by insects or weeds. *Pastures*—On dry land it was very bare; on heavy land quite abundant. *Live Stock*—Better than could be expected. Cattle and sheep were free from disease. *Clip of wool*—Quality and weight were a good average.

DUMFRIESSHIRE (Eskdale). *Wheat*—None grown. *Barley*—None grown. *Oats*—A very good crop; much better than last year, although it did not look very promising in June owing to the dry weather, but this being a late district the rain came in time, and was the means of improving the crop considerably. Would average from 32 to 36 bushels per acre; quality of grain and straw very good; seed sown, about 5 bushels or a little over per acre. *Harvest* commenced about the usual time, in end of August, and with good weather the crop was secured in good order. *Hay*—Rather better than last year, unless on very light land; about 24 cwt. per acre, mostly well mixed with clover; where not got during the dry weather, was very much wasted; aftermath very good. *Meadow-hay*—Not such a good crop as last year; about 23 cwt. per acre; some much wasted at beginning, but what was secured later was in good order. *Potatoes*—About the same as last year—6 tons; disease not bad, and did not commence very early. No new varieties planted. *Turnips*—A good crop, and better than last year, particularly the earlier sown ones; those sown later did not braird regularly owing to the land being too dry; little or no resowing required. *Insects*—No insect pest. *Weeds*—No weeds, the ground being dry during the thinning season. *Pastures* started well, but got very much used up during latter end of dry weather; shortly after the rain came they improved quickly, and lasted out fairly well. *Live Stock* thrived very well, and were in good order in back-end. Cattle and sheep free from disease. *Clip of wool* perhaps full average, but short of last year; quality good.

KIRKCUDBRIGHTSHIRE. *Wheat*—None grown. *Barley*—None grown. *Oats*—Generally under average; 45 bushels per acre; 4 bushels sown. *Harvest* began usual time. *Hay*—Light crops; about 30 cwt. per acre. *Meadow-hay*—About same as last year. *Potatoes*—Early varieties a light crop; late varieties good, but 15 per cent diseased; no new varieties of any consequence. *Turnips*—Much under last year; brairded irregu-

larly, and some resowing owing to night frosts and cold weather. *Insects*—No particular insect damage. *Weeds*—No damage by weeds. *Pastures*—Poor at beginning; very good in autumn. *Live Stock* thrive well. Cattle and sheep free from disease.

WIGTOWNSHIRE. *Wheat*—Very little grown; 45 to 48 bushels; grain and straw very good; 4 bushels sown per acre. *Barley*—Very little grown; 40 to 42 bushels; grain fair quality; straw light. *Oats*—45 to 48 bushels per acre; both grain and straw very fine quality; seeding nearly 4 bushels with drill and 6 bushels with hand sowing; in some districts the weight of straw was below average, but generally speaking the crop was excellent. *Harvest*—A little earlier than usual; general by 1st September, and finished by the end of the month. *Hay*—Owing to the long spell of dry weather the crop was light; from 25 to 30 cwt. per acre; quality very good. *Meadow-hay*—The meadow-hay was light—about 25 cwt.; much less than last year; timothy hay an excellent crop; from 45 to 50 cwt. per acre. *Potatoes*—From 6½ to 10 tons per acre; much the same as last year; no disease; no new varieties. *Turnips*—14 to 20 tons per acre, but increased greatly in weight after proofing owing to the open winter; quality excellent; much better than last year; braided well. No pests. *Weeds*—No weeds; fine dry weather and every chance for cleaning the land. *Pastures*—Where winter hained young seeds grazed well during the summer, but the second, third, and fourth years' grasses were bare all the season; in many fields there was a great want of water for stock to drink. *Live Stock*—Stock did wonderfully well where they had water, but feeding had to be given on many farms. Cattle and sheep free from disease. *Clip of wool*—Ewes on hill land would clip lighter than usual, but sheep on low land would be quite an average.

GLASGOW DISTRICT.

AYRSHIRE. *Wheat*—45½ bushels; 36 cwt. straw; all good quality; about 3 to 3½ bushels seed. *Barley*—44 bushels; 27 cwt. straw; all good quality; about 3 to 4 bushels seed. *Oats*—50½ bushels; 24 cwt. straw; all excellent quality; about 5 to 7 bushels seed. *Harvest* about ten days earlier than usual. *Hay*—Ryegrass, 29½ cwt. *Meadow-hay*—32 cwt. per acre. *Potatoes*—8 tons 10 cwt. per acre; of good quality; no disease; no new varieties of any account planted. *Turnips*—22 tons per acre; braided fairly well, unless late in the season when there was not enough moisture in the soil, and in these cases resowing had to be resorted to. *Insects*—Not more than usual. *Weeds*—Not to the same extent as usual; the very dry weather enabled the weeds to be killed with less labour. *Pastures*—The dry weather did not stimulate growth, and pastures were very bare all the summer and autumn. *Live Stock* did not thrive at all well, especially on the drier lands. On deeper lands, however, and with plenty of moisture, grass was plentiful and stock thrive well. Cattle and sheep were generally free from disease. *Clip of wool*—Good; about average weight.

BUTE. *Wheat*—Only 1 boll sown; 40 bushels. *Barley*—Only a few acres grown, but a very fine crop on good barley land; 65 bushels; 2 tons straw; excellent quality; 4 bushels sown. *Oats*—48 bushels; 2 tons straw; above average of grain and straw; 5 bushels sown. *Harvest* began third week of August; best crop for the last ten years. *Hay*—Very light crop, but good quality; about 1 ton to the acre. The follow-

ing clover was a very strong crop. The hay was mostly sold to the Government from £5 to £5, 5s. per ton. *Meadow-hay*—Very little grown, and under average of previous years. *Potatoes*—Digging began 18th June; till 30th July the crop averaged 8 tons an acre; from 1st August onward it would average 10 tons. The usual varieties planted, with practically no disease. A new variety, "The Bute Marys," is a large cropper and very fine quality; if it continues it will be one of the best potatoes that has been grown for a long time. *Turnips*—Above average; a very large crop—from 25 to 35 tons an acre. No injury from insects or weeds. The oat crop in some parts near hedges was very much damaged by sparrows. They should be kept down, as they have increased very much during these last few years back. *Pastures*—The pasture during the early part of the summer was under the average, but in the latter part of summer it was very abundant. *Live Stock*—The stock thrived well. Cattle and sheep were free from disease, excepting the usual number of lambs which die annually from "braxy." *Clip of wool*—An average clip, and good quality.

ARRAN. *Wheat*—None grown. *Barley*—Very little grown; say 5½ quarters per acre; well got, and quality fair. *Oats*—A very good crop; 35 to 38 bushels per acre; seed sown, about 6 bushels; grain above average in quality. *Harvest* a few days earlier than previous year; cut nice and ripe, and well secured. *Hay*—A light crop, but well got; say about 1 ton per acre. *Meadow-hay*—Little grown; fair crop, and well got. *Potatoes*—Early potatoes an extra big crop; later kinds filled up fairly well, but a good many small tubers; say 6 to 7 tons per acre; "Arran Chiefs," about 10 tons. *Turnips*—A moderate crop, but grew well in the autumn; clean, and not much disease. No injury by insects or weeds. *Pastures*—Moderate growth; rather dry in the earlier months; burned up on light land in June, but grew well after the rain. *Live Stock* did not thrive so well as previous year, being rather short of grass in June. No disease in cattle or sheep. *Clip of wool*—Rather less weight than 1914, but quality good, and prices up 3s. to 4s. per stone from last year.

LANARKSHIRE (Upper Ward). *Wheat*—None grown. *Barley*—None grown. *Oats*—35 to 40 bushels; grain good quality; straw shorter; 5 to 6 bushels sown. *Harvest* general first week in September; earlier than the average; short harvest; weather good. *Hay* about 1½ tons; lot of hay wasted by bad weather. *Meadow-hay*—Much the same as last year. *Potatoes*—Less than last year—5 to 7 tons—owing to frosts on 18th June and 3rd September. Frost also on 13th November, and a good many potatoes not lifted were rendered useless. "Arran Chiefs," heavier crop, and no disease. Some of the earlier varieties showing a lot of disease. *Turnips*—25 to 30 tons; crop braided well; some resowing owing to frost and dry weather. Good many turnips not secured before frost on 13th November which did a lot of harm to crop. No injury by insects or weeds. *Pastures* burnt up during forepart of summer, but improved later. *Live Stock*—Quite well. Cattle and sheep free from disease. *Clip of wool*.—Good; over average.

LANARKSHIRE (Middle Ward). *Wheat*—The autumn of 1914 was exceedingly favourable for the seeding of wheat, and a larger area of wheat was sown than in former years. The dry warm summer suited the growth of the crop, and the produce of grain and straw was heavier than for some time. Grain, 35 to 48 bushels; straw, 35 to 45 cwt.; seed sown, 3½ to 4 bushels. *Barley*—None grown. *Oats*—The season being

a dry warm one was not so suitable for oats on light land, but over all the yield was above the average, and the quality of grain and straw was very fine. Grain, 36 to 50 bushels; straw, 20 to 35 cwt.; seed sown, 5 to 6 bushels. *Harvest* commenced at the usual time, and was favoured with good weather. All the crops were secured in good condition and with the minimum of labour. *Hay*—Ryegrass and clover-hay were very light owing to the dry weather, but where the land was in good condition a second cutting of hay was secured later on, which in many cases made up for the shortage in the first cutting. The produce per acre was from 25 cwt. to 2 tons. Prices in July and August were fixed by Government, £3, 15s. to £4 per ton, rising in succeeding months up to £6, 10s. *Meadow-hay*—Timothy hay gave a fair yield, but on a number of farms the produce was much spoiled by three weeks' continuous rain. *Potatoes*—The potato crop suffered in the spring from late frost. The weight of the crop would be from 5 to 10 tons per acre. *Turnips*—The dry season did not favour the growth of turnips, and much loss was caused by finger-and-toe. In the autumn the turnips which were not secured were caught by the early frost, and much loss was caused thereby. The yield would be from 10 to 20 tons per acre. No injury was caused by insects or weeds. *Pastures*—Where the pasture was not severely eaten in the early spring it did well, and during the autumn was very plentiful. *Live Stock*—All stock have been exceedingly high in price owing to the war, and cattle have been free of disease. *Clip of wool*—There are no sheep in this ward.

LANARKSHIRE (Lower Ward). *Wheat*—40 to 42 bushels; quality very good; straw fair—rather under 2 tons; 4 bushels seed per acre. *Barley*—Only limited quantities grown. *Oats*—A full average—50 to 54 bushels; good quality; straw fine quality; quantity according to soil—6 bushels generally sown. *Harvest* rather earlier than usual; fine weather; crop secured in very good condition. *Hay* under an average—from 25 to 30 cwt. per acre; quality inferior owing to unfavourable weather. No meadow-hay grown. *Potatoes*—5 to 8 tons per acre, partly diseased. *Turnips*—Swedes a variable crop—considerably under the average; braided well; suffered from drought in September. No injury from insects or weeds. *Pastures* quite an average. *Live Stock* did very well. Cattle and sheep free from disease. No clip of wool.

RENFREWSHIRE. *Wheat*—40 bushels; about 2 tons straw; quality of both grain and straw quite up to last year's average; 4 bushels of seed per acre. *Barley*—None grown. *Oats*—60 bushels; about 30 cwt. of straw; quality of both grain and straw much the same as last year; 5 bushels of seed to the acre. *Harvest* about eight days earlier than last year; a good harvest. *Hay*—1½ tons; quite good, but bad weather to commence with affected the quality. *Meadow-hay* quite as good as formerly. *Potatoes*—Average—7 tons; no disease to speak of; "Arran Chief" and "Golden Wonder" gave good results. *Turnips*—20 tons; quality hardly as good as last year's crop; braided all right; no resowing except in a few exceptional cases where fly troublesome. *Insects*—Not more than usual. *Weeds*—Not where attention given. *Pastures* not quite up to average growth, but better quality than last year. *Live Stock* thrive well. Cattle and sheep free from disease. *Clip of wool* quite up to average.

ARGYLLSHIRE (Lochgilphead). *Wheat*—None grown. *Barley*—None grown. *Oats*—Much about the same as last year—say 6 quarters; both grain and straw very good; in some places straw short; seed sown,

about 5 bushels. *Harvest* began about the usual time—25th August; an excellent harvest as regards weather. *Hay*—Hay crop light as a rule; not more than $1\frac{1}{2}$ tons for ryegrass. *Meadow-hay*—Not so bulky as last year; both ryegrass and meadow-hay suffered from the dry summer. *Potatoes*—A very good crop; about 8 tons per acre; very little disease; “Arran Chief,” a new variety, grew a big crop, and good quality. *Turnips*—Not so heavy as last year; on an average not more than 18 tons; a good deal of resowing owing to the young plants getting nipped with frost. *Insects*—Crops not injured by insects. *Weeds*—Not much trouble with weeds. *Pastures* not nearly so luxuriant till late on in the season, but of excellent quality. *Live Stock* thrived very well indeed. Cattle and sheep free from disease. *Clip of wool*—Very good quality, and rather above the average.

ARGYLLSHIRE (Kintyre). *Wheat*—None grown. *Barley*—Better than last year; 40 to 50 bushels; well harvested. *Oats*—Fully better than last year; from 6 to 7 quarters; 5 bushels seed per acre. *Harvest* about the usual time. *Hay*—Ryegrass fully as good as last year; well got; quite 2 tons to the acre. *Meadow-hay*—Barely so good, but well got. *Potatoes*—Early potatoes better than last year; late ones also rather better; not much disease. *Turnips*—Much the same as last year—about 20 tons; braided well; no second sowing. Not injured by insects to any extent. No damage by weeds. *Pastures* rather bare; too dry weather. *Live Stock* thrived quite well. Cattle have been free from disease; braxy was bad in some places. *Clip of wool* was rather over the average, and quality quite as good.

ARGYLLSHIRE (Islands of Islay, Jura, and Colonsay). *Wheat*—None grown. *Barley*—Practically none grown. *Oats*—In some of the lighter soils the crop was affected by drought, but taken all over the crop was an excellent one. *Harvest*—About ten days later than usual. *Hay*—Owing to dry weather the crop was lighter, and quality not so good; about $1\frac{1}{2}$ tons per acre. *Meadow-hay*—Similar to last year. *Potatoes*—An excellent crop; not much disease; 6 to 8 tons. *Turnips*—Quite as good as former years; about 18 tons per acre. *Insects*—No damage was done by insects or weeds. *Pastures*—Average growth and quality of last year. *Live Stock* thrived well. Cattle and sheep free from disease. *Clip of wool*—Good; over the average.

STIRLING DISTRICT.

DUMBARTONSHIRE (Upper). *Wheat*—None grown. *Barley*—None grown. *Oats*—About 32 bushels per acre; quality of both grain and straw good; quantity of straw much the same as last year, but below the average; about 6 bushels sown. *Harvest* began about the usual time—26th August. *Hay*—Ryegrass hay much the same as last year; if anything rather lighter; $1\frac{1}{2}$ tons per acre; quality in some cases spoiled by rain. *Meadow-hay* was lighter than last year, but it was secured in good order. *Potatoes*—About 7 tons per acre—about a ton better than last year; very little disease; no new varieties. *Turnips*—About 20 tons; braided well; only one sowing. No insects or weeds. *Pastures*—Grass was backward till after June owing to the cold dry weather; after that it was good. *Live Stock* thrived well. Cattle and sheep free from disease. *Clip of wool*—Quality of wool was good, but weight less than last year.

DUMBARTONSHIRE (Lower). *Wheat*—Small acreage grown; 34 to 36 bushels per acre; quality very good; seed sown, from 3 to 4 bushels. *Barley*—Little or none grown. *Oats*—Average about 34 bushels; straw a little lighter than usual; quality of both grain and straw good; 5 to 6 bushels sown. *Harvest*—Fairly early—about the 18th August. *Hay*—Ryegrass a little lighter than last year. A good deal of the crop was damaged more or less by the wet weather in July. *Potatoes*—About 7 tons per acre; not a great deal of disease. *Turnips*—From 18 to 20 tons on an average; briarded fairly well. No insects or weeds. *Pastures*—Average growth and quality of last year. *Live Stock* thrived well, and where fattened and sold off grass left more profit than the younger race of farmers remember. Cattle and sheep free from disease.

STIRLINGSHIRE (Western District). *Wheat*—None grown. *Barley*—None grown. *Oats*—About 40 bushels; grain and straw good quality; seed, about 5 bushels. *Harvest* began 30th August, being a few days later than last year, and finished about 1st October. Crop very well got. *Hay*—About 1 ton 10 cwt.; much the same as last year. On some farms well got; on others, badly damaged by rain and on the ripe side when cut; about usual quantity of clover. *Meadow-hay*—Much the same as last year; well got. *Potatoes*—Average about 8 tons. Some of the early varieties, viz., "Epicures" and "British Queens," would lift from 11 to 13 tons per acre; no disease at lifting, and kept well in pits. No new varieties planted. *Turnips*—About 30 tons per acre; quality good, but badly damaged by frost in November. Long in braiding on account of dry weather; one sowing in most places. No damage from insects. *Weeds*—Not more than usual injury from redshank. *Pastures* suffered from drought early in the season, but did better later on. *Live Stock*—Cattle thrived fairly well. Cattle and sheep free from disease. *Clip of wool*—Average quality and clip.

STIRLINGSHIRE (Eastern District). *Wheat*—48 bushels; grain very good quality; 30 cwt. straw, good quality; 4 bushels seed sown. *Barley*—44 bushels; grain generally well ripened, but some districts not well ripened; 22 cwt. straw; 4 bushels seed. *Oats*—44 bushels; grain not so well ripened—some greens in it; 23 cwt. straw; 5 bushels seed. *Harvest*—Usual time. *Hay*—48 cwt. per acre; indifferent quality; bad weather. *Meadow-hay*—Very poor crop in some places. *Potatoes*—8 tons per acre; quality good, but early sorts very much diseased. *Turnips*—27 tons; crop briarded well; not any second sowing. *Insects*—Turnip crop injured by fly. No weeds. *Pastures*—In early season pastures were very poor—too dry; but after August plenty of grass. *Live Stock*—First part of year stock did not thrive, but after rain made great progress. Cattle and sheep free from disease. *Clip of wool*—Very short of average; early summer was too cold and dry, and early lambing ewes were very short of turnips.

CLACKMANNANSHIRE. *Wheat*—A good crop, at least a full average of grain and straw; quite equal to last year; 40 to 46 bushels per acre; 3 to 4 bushels sown. *Barley*—Only a fair crop; less area sown than usual; 32 to 36 bushels per acre; seed sown, $3\frac{1}{2}$ to 4 bushels. *Oats*—A good crop, but not quite up to last year's bulk, but being well got in the straw and grain are of good quality; 40 to 44 bushels per acre; 4 to 5 bushels sown. *Harvest*—Except on a few early farms harvest commenced about the same time as last year, and was a fair good harvest in general. *Hay* was a little under the average except on heavy land; dry weather in the end of May and in June kept it back; the hay harvest was not so good as last year, and the crop was not so well secured; 2 to

2½ tons per acre. *Meadow-hay*—Rather a poor crop, and not well got; a good bit under last year's average. *Potatoes*—This crop varies a good deal in different parts of district; all over, the crop is a good bit under the average, and not so good as last year; there is more disease than last year. *Turnips*—A good crop where early sown, but dry weather in June kept back late-sown ones; on the whole there was more bulk than last year; owing to early frost the greater part of the crop was badly got in, and consequently not keeping well; there was not much re-sowing. *Insects*—There was very little damage by insects during the whole season. *Weeds* were not troublesome. *Pastures*—The grass did fairly well all the season through, being fully better than last year. *Live Stock* thrived well on the grass, and continued to do so until the end of the season. Cattle and sheep free from disease. *Clip of wool*—The clip of wool in quantity and quality was a full average.

PERTHSHIRE (Western District). *Wheat*—Crop about an average, but short in straw; grain, 40 bushels; seed, 3 to 3½ bushels per acre. The area of wheat grown was rather larger than in 1914. The crop was secured in good condition. *Barley*—The crop was under the average, and especially as regards straw; crop has not threshed out too well, but quality of grain is good; yield, 28 to 30 bushels; seed, fully 4 bushels; crop was fairly well secured. *Oats*—An average crop, though in some districts the bulk of straw is deficient. The crop is threshing very well, and the quality of grain excellent. In some of the later districts the crop was not secured in the best of order; yield, 36 to 40 bushels per acre; seed, 4 to 4½ bushels per acre. *Harvest* was general about a week or ten days later than last year. The weather in the early part was favourable, but broke down about the third week of operations, and remained so for fully a fortnight. *Hay*—The yield of hay of all kinds was decidedly under the average, and on some dry field farms it could not be cut at all. The quality is only fair, as the rains of July damaged the crop badly. On Carse farms the yield would be about 35 cwt. per acre, and on dry-field land not much over 20 cwt. per acre. Timothy hay on Carse land did not suffer so much from drought, and would be about an average crop. *Meadow-hay* is not grown to any great extent, but where it was cut for hay the bulk was very deficient and the quality poor. *Potatoes*—A good crop when growing, but latterly disease set in. Conditions at lifting time were bad, and there are many fields, in some parishes over 100 acres, in which the crop is still in the ground (January 1916). The crop would yield 8 to 9 tons at lifting time, and the quality is good. *Turnips* were a fair crop, and though they suffered a good deal from the early droughts they made a good growth in the early autumn. The quality is good, but unfortunately three-fourths of the crop remained on the ground when the severe frost set in at the middle of November, and much damage has been done to the roots; about 16 to 18 tons per acre. The crop braided well, and no second sowing was necessary. *Insects* and *weeds* gave no trouble, as the dry weather helped the destruction of the latter. *Pastures* suffered from drought in the early part of the season, and first year's pastures did not seem to have recovered from the drought of 1914, when the young grass was very ill-grown at harvest. Old pastures stood out well. On several farms the cartage of water to stock was a serious item. *Live Stock*—Cattle did well where the pasture was an average, and where bought in spring and sold about July they were paying for their keep in a very handsome manner. Cattle and sheep free from disease. *Clip of wool*—The clip of wool was decidedly over an average, and of good quality. The ewe stock on hill farms did not come through the late winter and early spring very well.

PERTH DISTRICT.

FIFESHIRE (Middle and Eastern District). *Wheat*—Crop under average; from 28 to 35 bushels per acre, with 25 to 30 cwt. of straw; quality good; the red variety stood the winter better than the white; the seed sown is from $3\frac{1}{2}$ to 4 bushels per acre. *Barley*—The poorest yield experienced for many years; from 26 to 34 bushels per acre, with a short bulk of straw, due probably to the severe frost in May; the seed sown is from $3\frac{1}{2}$ to 4 bushels per acre. *Oats*—The best crop of the season, yielding well—especially the newer varieties; 45 to 55 bushels per acre, with a good bulk of straw; seed sown is from 4 to 6 bushels per acre, according to variety. *Harvest*—The harvest was about the usual time, lasting rather longer than usual owing to bad winning weather at the beginning. *Hay* was under average in yield, and a considerable quantity partially spoiled both in the swathe and field rick through excessive rain; an average yield of $1\frac{1}{2}$ to $1\frac{1}{4}$ tons per acre; an exceptionally heavy crop of aftermath followed, rich in clover, which in many cases was made into second cut hay. *Meadow-hay* was much above the average when it was secured in good order, but a considerable quantity was spoiled by rain. *Potatoes*—The potato crop was heavier than usual, but this was discounted by the great quantity of tubers affected with disease in the softer varieties; where free from disease the yield would be from 5 to 7 tons per acre. *Turnips*—The crop of turnips was very irregular this year; on farms where generously manured a large crop resulted, especially in swedes, and these have emerged from the severe early frost little the worse owing to a plentiful covering of shaws; yield, from 25 to 30 tons per acre. Moderately managed crops from 16 to 20 tons per acre; the crop braided well, and there was little or no resowing. *Insects*—There was little or no injury to crop by insects. *Weeds*—On account of the scarcity of field labour there were more weeds than usual this year. *Pastures*—The pastures were of average growth and quality. *Live Stock* thrived well. With the exception of "wooden tongue" in cattle stock were free from disease. *Clip of wool*—The quality of the clip of wool was about an average.

FIFESHIRE (Western District). *Wheat*—Reports of the wheat crop are unfavourable; the grain is of good quality, but the yield falls short of previous years; probable yield, about 30 bushels per acre, but in some cases even less; the straw is of good quality but is short in quantity; usual seeding, about 4 bushels broadcast. *Barley*, like wheat, is also a disappointing crop as regards yield, and will also be short of the average of the past few years; the average yield may be stated at 30 to 36 bushels per acre; straw is short in quantity but of good quality. *Oats*, unlike the other cereals, have been the crop of the season; the grain and straw is of good quality; probable yield of grain estimated as high as 80 bushels per acre, and in some cases it is said to be more. *Harvest* commenced about the usual time, but in some of the late districts it probably would be later. *Hay*—The hay crop was most disappointing; few crops would yield over two tons per acre; the cold weather in April checked the growth of the young plants. *Meadow-hay*, unless where grown on bog lands, was a light crop, and much of it was destroyed by wet weather during the hay harvest. *Potatoes*—The potato crop was a disappointing one for growers; the yield was greater than we have had for some time, but the out-turn of sound tubers will be small; reports state that more than half the crop is diseased; the disease was first noticed after the heavy rains in July, and the further

wet weather in October increased the damage. *Turnips*—The turnip crop is turning out well and of good sound quality; the July rains helped forward the later-sown seeds; few cases of second sowing are reported. *Insects*—A few isolated cases of wheat being attacked by wire-worm and grub, otherwise crops were free from insect pests. *Weeds*—All crops were free from weeds. *Pastures* were very bare during most of the summer; in the autumn grass was more plentiful. *Live Stock*—Stock were lean when put out to graze, but as a rule they thrived well. No reports of disease in cattle or in sheep. *Clip of wool*—The wool clip was of good quality, but was, however, probably under an average due to the lean condition of sheep during the winter.

PERTSHIRE (Eastern District). *Wheat*—A very good crop of excellent quality; yield, about 36 bushels per acre; seed, 3 to 4 bushels per acre. *Barley*—A medium crop of good quality; yield about 34 bushels; seed, 3 to 4 bushels per acre. *Oats*—A lightish crop—good quality; yield, about 44 bushels; seed, 4 to 6 bushels per acre. *Harvest*—About the usual time. *Hay*—A poor, light crop, and mostly secured in very bad condition; yield, about 26 cwt. per acre. *Meadow-hay*—Less production than last year; very little grown. *Potatoes*—Not so heavy as last year; yield, about 5 tons per acre. Up-to-Date varieties very badly diseased—in some cases 75 per cent; Arran Chiefs and Evergoods did very well. *Turnips*—Only a fair crop—blanky, and a good deal of finger-and-toe disease. Turnips have also suffered from the early winter, and only a small portion could be stored. *Insects* and *Weeds* caused no more damage than usual. *Pastures*—Good upon the whole; they improved as the season advanced. *Live Stock*—All right. Cattle and sheep free from disease. *Clip of wool*—About average.

PERTSHIRE (Central District). *Wheat*—The quality and quantity was, on the whole, good; 35 bushels; straw, $1\frac{1}{2}$ tons; 3 bushels sown. *Barley*—An average crop; 40 bushels; a portion, however, not so well coloured; 4 bushels sown. *Oats*—A light crop on sandy soil, but a good crop on medium and heavy land; quality good; 42 to 44 bushels; straw good. *Harvest* began about the middle of August and was completed before the end of September. The harvest was completed generally in good weather. *Hay*—Clover hay crop, from 28 to 35 cwt.; quality—early cut, medium; late cut, well got. *Meadow-hay*—Quantity from 25 to 35 cwt.; well got. *Potatoes*—The crop was, on the whole, a good one, and those lifted early were secured in good condition. The average crop would be from 6 to 10 tons per acre. Unfortunately, potatoes that were not secured before the severe frost in October were destroyed; tubers as a rule free of disease. *Turnips*—Very good; 15 to 25 tons per acre; finger-and-toe bad in certain districts; very little mildew; very little second sowing. *Insects*—Wire-worm destroyed patches of the white grain crop on some farms. *Weeds* gave some trouble owing to the wet weather. *Pastures* good and bulky. *Live Stock* thrived well, and the prices obtained for these were very high. Cattle and sheep free from disease. *Clip of wool*—Very good—a full average, and quality good.

PERTSHIRE (Highland District). *Wheat*—None sown. *Barley*—Very little sown. Such as it was turned out a very poor crop; about 28 bushels, and short in straw. *Oats*—A very irregular crop. Lea had fairly long good straw, and an average turn-out of grain, but oats after green crop was short in straw, and did not thresh well; average, 42 bushels; 6 bushels sown. *Harvest* began about ten days later than usual; was much prolonged owing to the scarcity of hands

and a few days' rain coming on towards the end of September. *Hay*—A very poor crop on the whole, but the mixture was very good; about 1 ton per acre. Aftermath in most places turned out a very good crop after the rain of the first week in August. *Meadow-hay*—Much less productive than last year, and in the uplands and glens where the sheep stock had been grazed till 1st June there was no meadow-hay. This was owing to the drought in June and early part of July. *Potatoes*—Much lighter crop than last year; about 4 tons of store, and the proportion of small much above the average. Dates and British Queens much affected with disease early in the season. "Arran Chiefs" and "Golden Wonders" seem to be more largely planted. *Turnips*—Early sown turnips turned out a disappointing crop; owing to the early drought they seemed to be stopped in growth. Later sown, although long in coming to the hoe owing to the drought, turned out a fairly good crop. The crop braided well. No second sowing; 12½ tons. Owing to the early and severe frost more than half of the crop has been lost. *Insects*—No crop suffered from insects. *Weeds*—Many of the green-crop fields suffered from overgrowth of weeds, caused by the lack of horses and men to do the tillage, and the damage was consequently greater than usual. *Pastures*—Very bare in the early part of the season, but improved by the 1st of August. The quality was better than last year, although not up to the average growth. *Live Stock*—All kinds of stock did very well on the grass, although much less feeding-stuffs had been used. Both cattle and sheep free from disease. *Clip of wool*—The clip of wool, both in quantity and quality, was above the average of the previous three years.

FORFARSHIRE (Western District). *Wheat*—Crop below average; 32 to 34 bushels; seed, same as last year. *Barley*—Although the barley crop looked almost an average crop, it is threshing badly; 30 to 32 bushels; on light land down to 20 bushels; seed as last year. *Oats* threshing well; 48 to 50 bushels; seed as last year. *Harvest* slightly earlier than usual; considerably later than last year. *Hay*—The hay crop was a poor one; first cut hay was of good quality; later cut not so well got; 25 to 30 cwt. *Meadow-hay*—Little meadow-hay grown. *Potatoes*—The potato crop was below the average; 6 to 7 tons. Some disease in "Date" varieties. "Arran Chief" and "President" practically free from disease, and very little in "King Edward." *Turnips*—Turnip crop was less than usual, although some good fields; 20 to 24 tons. No second sowing was required. The frost has spoiled some on the lower-lying fields, but not to the extent expected. Very few were got stored. *Insects*—Not to any great extent. *Weeds*—"Skellies" abundant as usual, but otherwise little trouble. *Pastures*—There was great scarcity of grass for stock in the fore-end of the season especially. By harvest there was abundance. *Live Stock* thrived and paid well. A few cases of anthrax. *Clip of wool*—Average.

ABERDEEN DISTRICT.

FORFARSHIRE (Eastern District). *Wheat*—36 bushels grain and 30 straw, both of very fair quality, but although an average crop, not so good as last year. Seed, 3½ to 4½ bushels per acre, according to method of sowing and condition of the soil. *Barley*—A disappointing crop; 28 to 34 bushels per acre, and 20 straw; the quality, however, very good. Seed, 3 bushels drilled in, and 4 bushels when sown broadcast. *Oats*—A very useful crop of 48 to 60 bushels of grain of excellent quality, and 25 straw, the

heavier yield being for the newer thick-skinned varieties, which are gradually taking the place of the old potato oat. Seed, for the newer varieties, at least 6 bushels, as the thicker the seeding the finer the straw, and $3\frac{1}{2}$ to 4 for the old potato oats. *Harvest* commenced on 24th August and finished well before the end of September; practically a five weeks' harvest at the most seasonable time of the year. *Hay*—A very poor hay crop; about 1 ton 5 cwt. per acre, and much of it damaged beyond all recovery by wet weather. *Potatoes*—An excellent crop—at least 8 tons per acre; much the same yield as the past two years. No disease to speak of amongst the "Evergood," "Northern Star," and "President" varieties, but the "Date" and "Dalhousie" types are generally bad. No new varieties worth mentioning this year. *Turnips*—A very unequal crop; on light soil about 20 tons per acre, and on stronger land, which withstood the summer and autumn droughts, from 28 to 30 tons. (Crop now very greatly damaged by the frosts and wet of November and December; no storing done, and weights will be greatly reduced by spring. No injury by insects. *Weeds*—Crops injured by ordinary sunweeds on account of the excessive and continual rainfall before second hoeing could be completed. *Pastures* rather more abundant than last year, with excellent grass everywhere in the later part of summer and early autumn. *Live Stock* did very well, although not up to the extra level of the previous year. Cattle and sheep free from disease except for an occasional case of anthrax amongst cattle. *Clip of wool*—The clip of wool (low-ground feeding sheep only) just fair, and the weight on the whole a little disappointing.

KINCARDINESHIRE. *Wheat*—36 bushels. Seed, 3 bushels drilled, and 4 bushels broadcast. *Barley*—32 bushels. Seed, 3 bushels drilled, 4 bushels broadcast. *Oats*—42 to 46 bushels. Seed, 4 bushels drilled, 6 bushels broadcast. *Harvest*—Usual time—i.e., end of August. *Hay*—1 ton per acre. Quality good; clover very deficient; aftermath very good indeed. *Meadow-hay*—Practically none grown. *Potatoes*—6 to 8 tons. Very little disease. *Turnips*—16 to 20 tons. No second sowing; braided well. No injury by insects or weeds. *Pastures*—Poor grazing year. *Live Stock* thrived quite well. Cattle and sheep free from disease. *Clip of wool*—Fair; quality good.

ABERDEENSHIRE (Buchan District). *Wheat*—None grown. *Barley*—Not so much ground under barley; crop as previous year. Quantity per acre about 1 quarter less than last year, and 1 to 3 lb. less weight per bushel—53 to 56 lb. per bushel. Seed, about 4 bushels. *Oats*—Fairly good seed time, but owing to drought in early summer months, especially in June, oat crop of 1915 is not nearly equal to that of 1914, being 1 to 2 quarters less per acre, and straw yield is also less. Weight of oats 1 lb. to 3 lb. less per bushel—being 38 to 41 lb. *Harvest*—Harvest commenced about the usual time—viz., about second week in September, except in late districts—and was concluded under fairly good conditions except in late districts, where the weather broke down before all was secured. *Hay*—Owing to dry early summer hay crop was under an average—about 25 to 30 cwt. per acre, secured in good order. *Meadow-hay*—Very little grown in this district. *Potatoes*—A very good crop. Quality very good; 5 to 6 tons per acre. Fully the usual extent of land under this crop. Scarcely any disease. A few new varieties were planted. *Turnips*—One of the best crops in the last few years, and practically free from disease. Weight per acre high—from 24 to 30 tons, and in exceptional cases even more. Crop braided well; very little re-sowing required. No injury by insects. *Weeds*—Crops were not injured by weeds. Weeds

were kept down by dry early summer. *Pastures* not too luxuriant during the early part of summer, which was dry, and owing to stock having to be put on earlier than usual because of scarcity of turnips, &c. *Live Stock* thrived fairly well on pastures. Cattle and sheep free from disease. *Clip of wool* of fair quality. A little over the average.

ABERDEENSHIRE (Central District). *Wheat*—None grown. *Barley*—32 bushels per acre; $8\frac{1}{2}$ bushels less than last year; weight 51 to 56 lb. per bushel. Straw 21 cwt. per acre; 5 cwt. more than last year. The grain is not so good as last year's crop; the quality of straw similar to last year. Seed, where drill machine is used, about $3\frac{1}{2}$ bushels per acre; where broadcast machine is used, about 4 bushels per acre. *Oats*—40 bushels per acre; 4 bushels less than last year; weight, 37 to 44 lb. per bushel. Straw 23 cwt. per acre; 1 cwt. more than last year. Neither the grain nor the straw is as good quality as last year. Seed, potato oats, and all old thin husked varieties where drill machine used, $4\frac{1}{2}$ to 5 bushels per acre; broadcast machine, 6 to $6\frac{1}{2}$ bushels per acre; new and thick husked varieties 2 to $2\frac{1}{2}$ bushels extra. *Harvest* commenced on the earlier farms in the first week of September, but was not general until the second week; fourteen to twenty-one days later than last year. Mostly all grain crops in this district were in the stackyard about the first week of October. Crops not secured before that time were greatly damaged. A very small proportion is to be seen still unsecured. *Hay*—Average 28 cwt. per acre; 3 cwt. per acre less than last year. The crop was not so well mixed with clover, and quality was not so good as last year. *Meadow-hay*—Average 21 cwt. per acre; $1\frac{1}{2}$ cwt. less than last year. *Potatoes*—Average $7\frac{1}{2}$ tons per acre; slightly less than last year. A good many cases of disease were reported from August onward to lifting. *Turnips*—Average $19\frac{1}{2}$ tons per acre, being 4 tons more than last year. Quality very much better than last year. The crop braided well, and continued to do well the whole season; no second sowing was reported and very few complaints of disease. No complaints of injury by insects. *Weeds*—No complaints on well-farmed land of damage by weeds. Smut on bere and barley was rather more prevalent than in an average year. *Pastures*—On account of the dry weather in May and June pastures were poor and bare in the early part of the season. Matters improved from the last week of June onwards to the end of the season, and although the season did not commence as well as last year, in the end there was probably little difference. *Live Stock*—All stock has done well. Cattle and sheep free from disease. *Clip of wool*—Neither the quality nor quantity was as good as last year, and would be under an average year. The failure of the turnip crop last year would no doubt in a measure account for this, as a large proportion of keeping sheep would be wholly grass wintered, and would not be in the same condition in spring as in an average year. The bareness and dryness of pasture also in the early part of the season would be against them. The price obtained for the clip this year as compared with last would, however, much more than square accounts. Some farmers got 9d. per lb. more this year than last year.

ABERDEENSHIRE (Strathbogie District). *Wheat*—None grown. *Barley*—Barley has never been grown extensively in this district, and during the past few years the tendency has been towards a smaller area, so that the crop of 1915 did not occupy a normal extent. The crop has threshed about 25 per cent below estimates formed before the commencement of harvest, while the bushel weight is at least a couple of pounds below the weight of last year's crop. The yield may be stated as

about 3½ qrs. per acre, and the weight per bushel about 54 lb. *Oats*—The oat crop was generally better than barley, still the bulk in straw was not quite satisfactory. The weather in June was entirely rainless, therefore not favourable to growth; then throughout the whole of the summer season it simply rained every day till September, which was generally dry. The yield may be stated at something under 40 bushels per acre, while the quality of even the best is not up to the average. The weight of the best ranges from 10 to 42 lb. per bushel. *Harvest* commenced about the first week in September, and in numerous instances was greatly protracted, with the result that much of the crop was irretrievably spoiled. *Hay* The weather during the hay season was most unfavourable, and great difficulty was experienced in getting it cut and cured. Much of the crop was greatly spoiled in the process, and some of it altogether ruined. Clovers were not abundant, with the result that the weight of the crop generally was under an average—perhaps about 25 cwt. per acre. *Meadow-hay*—No meadow-hay grown in the district. *Potatoes*—Potatoes gave a fairly good yield, and the quality was also fairly good considering the wet and sunless season. While these notes are penned (2nd February 1916) there are still to be seen on many Strathbogie farms a portion of the crop to lift. No disease of any consequence amongst the tubers. “*Arian Chief*” is being planted, and so far good results have been obtained. *Turnips*—The turnip crop was rather variable, but on the whole below an average. The plants came along to the hoe all right, and no second sowing was necessary. The crop may be stated to range between 15 and 20 tons per acre. *Pastures*—The pastures were of average growth during the season, but owing to the abnormal rainfall they become rather washy, so stock did not do so well towards the end of the season. *Live Stock*—No disease among cattle and sheep. *Clip of wool*—The clip of wool was generally considered to be under an average weight. The spring season was unfavourable to growth, and the weather before clipping time being cold caused an absence of fleece which tends to increase the weight of the clip.

BANFFSHIRE (Upper District). *Wheat*—None grown. *Barley*—Very much less area under barley last year, and a less return per acre from what was sown; the greatly enhanced price made up the deficiency very much, 60s. per qr. being obtained in one or two cases, and the general run being from 53s. to 57s. per qr. *Oats* came away very well, as the seed was strong, and no damage was caused by grub. The late cold summer weather and sunless days of August failed to mature the crop, and it is threshing poorly, quite a third under a normal average; very little comes up to 4 qrs. per acre, and the weights are under the standard—42 lb. per bushel. *Harvest* was later by three weeks, and the weather was very snatchy, frosty mornings damaging the grain and retarding work; then a complete breakdown in the last week of October caught farmers with much crop exposed, and all through the next two months the crops were exposed in stook or in cole, and grain eaten up by vermin and game. *Hay*—The hay crop suffered badly from a cold May and dry June, and, as a rule, was very deficient in clover; very little of the crop came to 100 stones per acre. *Mead. w-hay* is not kept up; the marshes are pastured as a rule when the sown fields get bare. *Potatoes* are cultivated only for home use; they are nearly all of the white varieties—“*Abundance*,” “*Up-to-Dates*,” “*Main Crop*,” &c. They were plentiful at the stems, but of rather small sizes, and some disease here and there. *Turnips*—The turnip crop was got in well, but hung back much in brairding from lack of moisture in June. There were isolated cases of second sowings of yellows in place of swedes. Altogether the

crop is barely an average. One can hardly state weights—30 to 40 loads comes off an acre where the crop is good. *Pastures*—Like the hay crop, the pastures were slow of filling up, and soon failed when fully stocked. *Live Stock*—Cattle and sheep thrive fairly well, but the pastures giving out early, the numbers had to be reduced; fortunately, farmers met with good prices at the period. *Clip of wool*—The sheep farmers have had a good time; wool prices extremely high, and a ready sale for all kinds of sheep at quite remunerative rates.

INVERNESS DISTRICT.

MORAYSHIRE. *Wheat*—Very little grown; thin on the ground, and late in ripening; about 44 bushels per acre. *Barley*—Quantity about 40 bushels per acre, or 4 bushels less than last year; straw about 36 cwt., or same as last year; weight of grain about standard; colour good where September floods were escaped; seed sown, 3 to 4 bushels. *Oats*—About 48 bushels grain, or $\frac{1}{2}$ bushel more than last year; straw about 43 cwt., or same as last year; quality of both grain and straw very good; seed sown, 5 to 8 bushels per acre according to variety. *Harvest* was late in beginning (well into August); in the earlier parts was secured before the September floods, which rivalled the famous Moray flood of 1829, and did enormous damage, not only by the rising of the rivers flooding the land on which the crops were—some not cut and some in the stook—but by the persistent rain soaking the newly erected ricks, piercing in many cases through the thatch, so that ricks which had been secured in good condition had to be carted out again. *Hay*—Quantity about 28 cwt., or 2 cwt. less than last year; poor crop, and not secured in good order. On deep, moist land an excellent crop was obtained—double the above amount. *Meadow-hay*—Little grown; crop fully better than last year; damaged a little by rain at harvest time. *Potatoes*—About 6 tons, or same as last year; disease rather prevalent amongst the late varieties increasing in the pits after storage. *Turnips*—About 18 tons per acre, or 4 tons more than last year. Turnip crop has been the crop of the year. In the low lands the September and later floods have damaged the crop after it was well matured. *Insects*—Damage less than usual. *Weeds*—Despite the shortage of labour, weeds less than usual. *Pastures*—Fully better all the season except for a dry period in early summer. *Live Stock* thrive well the whole season. Cattle and sheep were free from disease. *Clip of wool* about the average as to quantity and quality.

NAIRNSHIRE. *Wheat*—None grown. *Barley*—Three quarters; dark colour, and lighter weight than usual; straw not bulking well, and not standing up in courts. *Oats*—Five and a half quarters; good colour; straw fair quality, but short in bulk. *Harvest* started a week later than the average. *Hay*—Both ryegrass and clover much behind last year; about 17 cwt.; bad quality through bad weather. *Meadow-hay*—None grown. *Potatoes*—About $5\frac{1}{2}$ tons; very similar to last year; disease only began to show after pitting, and as yet not to a very large extent. *Turnips*—About 15 tons; better quality; in most cases they came away fine, more especially the early sowings. In a few cases they had to be twice sown, and some were left unsown until the rain came in the middle of July, when they came away very well. *Insects*—Just about the usual damage, grub being the offender; crows pick the plants out looking for grub. *Weeds*—Not more than usual. *Pastures* quite as good as usual to start with, but did not last so long. *Live Stock* all right. Cattle and sheep free from disease. *Clip of wool*—A good average clip.

INVERNESS-SHIRE (Inverness District). *Wheat*—A very slight increase in acreage; return per acre about same as last year. *Barley*—Return very disappointing; about 28 bushels per acre; natural weight below standard, and deficient in straw; seed sown, from $3\frac{1}{2}$ to 4 bushels. *Oats*—Below average return, with a proportion of unfilled grain; and below average in straw; seed sown, 5 to $7\frac{1}{2}$ bushels—the latter new varieties. *Harvest* began at usual time, 1st September, but very protracted; about one-fourth of crop lay in fields many weeks through cloudy weather, which darkened straw and grain but caused little sprouting. *Hay*—Quantity and quality much below average, and quality much spoiled by incessant wet and sunless weather. *Meadow-hay*—Very little grown. *Potatoes*—Below previous year, with a few instances of disease, but on the whole fair quality; some new varieties grown successfully. *Turnips*—An average crop, although very stiff on account of dry weather in June and early July, but later proved a remunerative crop, and generally free of “finger-and-toe.” *Insects*—Less than average damage. *Weeds*—The early summer was very favourable to keeping down weeds; later, with conditions more favourable to growth and shortness of labour, fields were not so clean as might be desired. *Pastures*—Autumn very favourable to growth of pasture, although rather dry during early summer. *Live Stock*—Stock thrived very well. Cattle and sheep very healthy. *Clip of wool* above average.

INVERNESS-SHIRE (Skye). *Wheat*—None grown. *Barley*—None grown. *Oats*—An extra good crop on the heavy land, but owing to the long spell of drought, on light land they were short and altogether a small crop. *Harvest* began about the usual time. *Hay*—Ryegrass and meadow-hay were an exceedingly light crop. *Meadow-hay*—Meadow-hay was the lightest crop on record. A large acreage was so short that it could not be cut. *Potatoes*—The potato crop was very abundant, being much above an average. *Turnips*—Turnips put down before term were a success, but later sown seed had to be resown. No insects nor weeds. *Pastures*—Pastures were much injured by the long spell of drought, and probably were never so bare. *Live Stock*—Stock did not thrive as well as usual owing to the want of grass. Cattle and sheep free from disease. *Clip of wool*—An average clip.

INVERNESS-SHIRE (Lochaber). *Wheat*—None grown. *Barley*—None grown. *Oats*—Straw and grain an average of last year; seed sown per acre, 6 bushels. *Harvest* 6 days earlier than last year. *Hay*—Average of last year. *Meadow-hay* crop less productive than last year. *Potatoes*—8 cwt. per acre more than last year; no disease; no new varieties. *Turnips*—11 cwt. more than last year; crop braided well; no resowing. *Insects*—Damage by wire-worm greater than usual. *Weeds*—Crops injured by “curron” weed; damage less than usual. *Pastures* were an average growth and quality with last year. *Live Stock* thrived well. Cattle and sheep free from disease. *Clip of wool* over the average.

ROSS-SHIRE (Dingwall and Munlochy). *Wheat*—Many more acres grown; quality fair; quantity average; straw good in quantity, but only fair quality; seed sown, about 4 bushels per acre. *Barley*—Not nearly so much grown. Quality of grain and straw quite an average; quantity of straw short of average; quantity of grain short of average, say 4 bushels per acre; seed sown, about 4 bushels. *Oats*—Quantity fully average; yield, say 50 bushels per acre; quality fine; quality of straw fine, but much below average in quantity; seed sown, 3 to 6 bushels per acre. The drought of June reduced the bulk of straw over all the cereals. *Harvest* began 23rd August. Weather continued

favourable, but not being droughty was rather tedious at first. *Hay* was quite an average. Drought before cutting rather affected the yield; the making was accomplished with difficulty owing to unsteady weather. *Meadow-hay*—None in district. *Potatoes*—Yield quite average; partly injured by early and later frosts; yield varies from, say, 5 to 7 tons; quantity below average. *Turnips*—Turnip crop very good; crop braided nicely; some second sowing; the later sowings braided unequally owing to drought; swedes, 15 to 25 tons per acre; yellows, 10 to 20 tons. *Insects*—No great injury from insects. *Weeds*—Not more than usual. *Pastures*—An average growth and quality, but the drought of June reduced the growth later. *Live Stock*—Stock thrived very well, and was free from disease. Cattle and sheep free from disease. *Clip of wool*—An average.

ROSS-SHIRE (Tain, Cromarty, and Invergordon District). *Wheat*—A good crop, averaging about same quantity of grain as last year, while straw was slightly less than last year. General average of grain about 40 bushels, good land producing up to 56 bushels; quality of grain not quite so good as last year; seed sown, 4 bushels per acre. *Barley*—A poor crop, averaging about 8 bushels less than last year. General average about 30 bushels, good land up to 44 bushels; grain poor quality; straw very short; seed sown, $3\frac{1}{2}$ bushels per acre. *Oats*—A fair crop, averaging about 4 bushels less than last year. General average about 52 bushels per acre. Some of the new Garton's and Swedish varieties up to 80 bushels per acre on good land; quality good when got in before weather broke; straw rather shorter than last year. Seed sown, 4 to 6 bushels per acre according to variety. *Harvest* began about end of August, ten days earlier than usual. *Hay*—A poor crop; about 5 cwt. per acre less than last year. General average about 25 cwt. per acre. Quality good where secured before weather broke, otherwise badly damaged. *Meadow-hay*—None grown. *Potatoes*—A fair crop; about 5 cwt. per acre less than last year; general average 6 tons 15 cwt.; very little disease. Of the new varieties tried "Arran Chief" and "Vitality" did well. *Turnips*—A good crop. General average 5 tons per acre better than last year; general average about 23 tons per acre of swedes and 20 tons per acre of yellows. Crop very sound; braided well; very few cases of second sowing. *Insects*—Very little trouble with insects. *Weeds*—Not much trouble with weeds except charlock, which was fairly bad this year on lands addicted to it. *Pastures* were very short all through the season. Owing to the shortage of turnips the year before, stock were put on the pastures earlier, and then when the drought set in the pastures were so bare they could not withstand it. The quality was good. *Live Stock*—Notwithstanding the shortage of grass stock thrived well. Cattle and sheep free from disease. *Clip of wool*—Quality good. Ewes clipped under the average. Hogs clipped about an average.

SUTHERLANDSHIRE. *Wheat*—None grown. *Barley*—None grown in this (Lairg) district of Sutherland. *Oats*—A fair crop, secured in excellent condition; straw and grain good quality; yield of grain about 44 bushels per acre. *Harvest* about usual time. *Hay*—Hay crop light; about 1 ton per acre. *Meadow-hay* crop less productive than last year. *Potatoes*—Potatoes a good crop; $5\frac{1}{2}$ tons per acre; excellent quality, and no disease. *Turnips*—Turnip crop short of last year owing to drought in June; 12 tons per acre; no second sowing required. No insects or weeds. *Pastures*—Pastures barer than last year owing to drought. *Live Stock* thrived very well. Cattle and sheep free from disease. *Clip of wool*—Excellent quality, and of average weight.

CAITHNESS-SHIRE. *Wheat*—None grown. *Barley*—A fair average yield, of good quality. The straw not being so suitable for fodder makes oats on the whole the more profitable crop throughout the county. *Oats*—The summer was very dry till the last days of June, when copious rains revived the crop and produced an average yield. There would be 24 to 32, and in some cases 80 bushels of well-matured grain per acre. The quality of grain and straw was very good, though rains made harvesting risky and urgent; seed, from 5 to 6 bushels. *Harvest* began to be general in third week of September; those who had sown early had two weeks of a start, and good weather. Keen hoar frosts in first week of October, intermixed with hail showers and fierce gales, so twisted and mangled the crop that machines or binders had great difficulty in the cutting. Large portions were so "laid" that scythes took them best up, and harvest work was unusually tedious and prolonged in consequence. *Hay*—The hay crop was fairly good, but the drought up to the end of June lessened the quantity, yet there would be an average of 2 or 3 tons per acre of mixed clover-hay. The aftermath was not so rich in clover as in 1914. *Meadow-hay*—Meadow-hay crop was up to last year, but it was more difficult to secure owing to heavy rain showers. *Potatoes*—The yield was nearly equal to last year, and in some cases over it; about 7 tons per acre. Disease showed itself in spots early in the season. The frosts of 1st and 2nd October blackened the shaws; the liftings showed that nearly one-half of the tubers was affected with disease, and also slight scabs occasionally. Champions succumbed most of all. "Abundance" and "Beauty of Hebron" were of good flavour and mealy. *Turnips*—The turnip crop came on after the June rains, and so did the weeds. Singling was difficult, but the crop came on well afterwards, and 20 tons or more could be carted from the acre. The seeds did not germinate in many parts of a row until rains in end of June and thunder-plumps in first week of July brought them up later in patches, so that no second sowing was necessary, but singling was done by stages. *Insects*—Insects did not damage crops to any great extent, and there were not so many ravages by "grub" as have been seen in previous years. *Weeds*—Thistles demand attention wherever they appear; they are certainly spreading. So are coltsfoot and sow-thistle (*Sonchus*). The scarcity of hands owing to the war makes it more difficult to grapple with these pests, and "liming" is prohibitive owing to expense. *Pastures*—The pastures at first were bare, but the moisture freshened them up, and they kept on till the harvest made other fields available. *Live Stock*—Stock came on well, and prices showed fat cattle to be in great request. Sheep and cattle did well. Scab seems to be extinct, or very nearly so, but anthrax appears in isolated cases. The local authorities keep on the alert with the view of having these stamped out. *Clip of wool* was very little under the general average of former years, and the reputation as to quality is well maintained.

ORKNEY. *Wheat*—None grown. *Bere*—Not quite so good as last year; yield, about 28 bushels per acre, weighing 49 lb. per bushel; seed, $3\frac{1}{2}$ to $4\frac{1}{2}$ bushels. *Oats* were sown in last week of April and first half of May. Cold frosty winds in May checked vegetation, but some fine showers and mild weather in July improved all the crops. The summer, until the 26th September, when there was a heavy fall of rain, was the driest in the memory of most people, and owing to the drought both oats and straw are considerably short of last year. The average yield is about 28 bushels per acre, weighing 38 lb. per bushel; seed, 4 to 6 bushels. *Harvest* began about the 27th September, being nearly a fortnight later than usual. *Hay*—Hay is considerably lighter per acre than last year,

and there is not much of it ; weight about 17 cwt. per acre. *Potatoes*—Potatoes were a fair crop, much the same as last year ; weight about 5 tons per acre. *Turnips*—Turnips were laid down in fine dry weather, and have turned out a fair good crop, much the same as last year ; weight about 12 tons per acre. There was little injury to the crops by either insects or weeds. *Pastures*—Pastures were, owing to the severe drought, very bare all summer, but the weather being fine and warm, stock thrived better than might be expected, and were healthy. *Clip of wool*—The clip of wool was rather over the average.

SHETLAND. *Wheat*—None grown. *Barley*—Very little grown. *Oats*—Straw fair crop ; grain much lighter than last year. *Harvest* about two weeks later than last year. *Hay*—Hay under the average. *Meadow-hay*—Much less productive : about half, owing to the cold month of June. *Potatoes*—Potatoes a fair crop as to quality, but quantity much under last year ; no disease. *Turnips*—Turnip crop excellent : only one sowing. *Weeds*—Very little damage done either by insects or weeds. *Pastures*—Pasture in June very far back, but revived in July and August. *Live Stock*—Stock did very well in July and August. Cattle and sheep free from disease. *Clip of wool*—The clip of wool was about an average.

THE WEATHER OF SCOTLAND IN 1915.

By ANDREW WATT, M.A., F.R.S.E., Secretary to the Scottish Meteorological Society.

THIS report consists of (1) a general description of the weather over the Scottish area from month to month ; (2) a selection of rainfall returns, in which each county in Scotland is represented by one or more stations. It is to be noted that all the temperature readings referred to are, unless otherwise stated, from thermometers exposed in the regulation "Stevenson Screen."

JANUARY.

The month of December 1914 had been extremely unsettled and wet, with barometric pressure as a rule at an abnormally low level, and in January 1915 also pressure was extremely low,—lower on the average than in any January since 1873.

Cold weather occurred around 10th and 17th, with lowest readings for the month in some districts on 10th, when the thermometer at Braemar fell to 13° ; but apart from these interruptions temperature remained at a fairly high level for the first three weeks or so. On 13th and 19th the nights were in most districts exceptionally mild, and the highest day reading of the month occurred nearly everywhere on the 13th, the

actual highest being 54° at Drumlanrig. Colder weather was experienced towards the end of the month.

The first half of the month was more or less unsettled and wet, though most districts had some dry days during that period, and the heaviest falls occurred on 1st, 3rd, 6th, and from 10th to 15th. On 12th Glencarron had $2\frac{1}{4}$ inches, and very heavy falls occurred in north-west from 12th to 15th, with a four days' aggregate at Kinlochquoich of fully 7 inches. From 16th onwards some eastern districts remained practically rainless, whilst elsewhere almost the only interruptions to a continuous dry spell occurred from 19th to 21st, when somewhat heavy falls were experienced in north-west, and at the very end of the month. The month's totals were below the normal in nearly all districts to the south of the Grampians, though about equal to the average in the extreme south-west; there was a well-defined excess in Aberdeenshire and in the Spey valley, and a moderate excess in some northern and north-western districts.

From 23rd to 30th comparatively quiet conditions prevailed, but outside that period the weather was at times extremely stormy, especially on 1st and 2nd, on 16th and 17th, and on 21st. Considerable snowfalls occurred in various districts from 8th to 10th, on 17th, and on 31st.

Hail was rather frequent, and thunderstorms occurred here and there on 1st, 2nd, 5th, or 15th.

Sunshine amounts differed little from the average except towards the north-east, where they were very deficient.

FEBRUARY.

The month was the third in succession with an abnormally low mean barometric pressure, with the result that the average pressure over Scotland for the December-February period (1914-15) was lower than during any winter for at least a hundred years. Except for a day or two about 25th the weather was of a cyclonic type, and a deep depression, which advanced towards the north of Ireland on the morning of 16th, was of special interest. Southerly gales developed in front of this disturbance, which followed a very irregular course round the north of Scotland and over the North Sea, and on evening of 17th two Zeppelins were wrecked near Blaavand's Huk during snow squalls.

The first few days of the month were in general very mild, with highest readings from 2nd to 4th, the actual highest being 56° at Inverness on 3rd. Thereafter there were various incursions of wintry weather, especially from about 12th to 17th; on 23rd and 24th, when the days were exceptionally cold; and on 28th. In various districts the mean of the fourth week was 7°

or 8° below that of the first week. The lowest reading reported was 11° at Kingussie on 24th.

Towards north-west the rainfall was below the normal, and in the extreme north there was only a moderate excess; but over a large part of central and southern Scotland the month was the wettest of the year, and in the southern counties and in various inland and eastern districts to the north of the Forth there was an abnormally large excess. Thus Braemar and Cargen had nearly three times the normal; and Dundee, Perth, Colmonell, Dumfries, and other stations at least twice the normal. In various districts the month was the wettest February since 1894, though in the Clyde area February 1911 was a wetter month, and at Braemar it was the wettest February on record. At the beginning of the month some very heavy falls occurred in west and south; and from 5th to 7th there were again considerable falls in many districts, especially towards the north-east. From 11th to 15th there was almost rainless weather in west and south, but on 16th heavy falls were general,—fully 2 inches at Leadhills,—with moderate amounts on 17th. From 19th to 25th there was but slight precipitation in most districts, except for snow on 23rd; but on 26th there were again very heavy falls, except in some eastern and northern districts—fully 2 inches at Cargen—with moderate falls on 27th and 28th.

Gales of considerable violence were experienced early in the month, and the weather was again very stormy on 17th and on 26th. Snow fell heavily in various districts from 7th to 12th, on 17th, and on 23rd; and at the end of the month a snowstorm of considerable intensity was general. In hilly districts there was much interruption of traffic. Flooding occurred in the Tay area and elsewhere during the first week or so, and at the end of the month.

Hail was rather frequent, and on the afternoon of 17th a thunderstorm occurred at various places.

Sunshine amounts were, as a rule, slightly below the normal.

MARCH.

After the first day or two mild weather was more or less general until the middle of the month, with unusually high day temperatures at times,—as high as 65° at Stonehaven, Kirkcaldy, and Kelso on 14th. There was for the most part an abnormal distribution of temperature over our Islands, greatly in favour of Scotland as compared with England, and during the second week of the month Aberdeen was on the average warmer than the Isle of Wight or Jersey. On 16th there was an abrupt change to a cold north-easterly type of weather,

which was hardly interrupted to the end of the month. Lowest readings occurred very generally from 18th to 20th, though in some districts from 27th to 29th or on 31st. The lowest reading was 11° at Balmoral on night of 19th, and in many districts a greater degree of cold was experienced at that time than had occurred since just before Christmas 1914.

As regards rainfall, very heavy amounts were experienced towards the north-west from 2nd to 5th, with moderate to heavy falls elsewhere. On 4th, falls of 2 inches or 3 inches occurred over considerable areas, and at some places that day was the wettest of the year,—as at Glenorchy Manse with 3.72 inches. From 6th to 15th dry conditions were interrupted, as a rule, only about 10th. From 17th to 24th falls of snow and rain alternated with dry days, whilst during the last week of the month some districts experienced but trifling precipitation until night of 31st, though in others snow fell at times. In some northern and western districts aggregates were above the normal; but, as a rule, there was a shortage, though this was but slight in north-east and south-east.

The snowstorm which had marked the close of February had spent itself on 1st or 2nd of March, and two or three days later, with heavy rain and melting snow, rather serious flooding was experienced in Perthshire and Strathspey. On 17th snow commenced to fall heavily in the north, and on the 18th a snowstorm of unusual severity for the time of year was general, with a gale from north-east in many districts. Drifting caused considerable interruption of traffic. From 25th to 28th there were various minor snowfalls, especially in north-east and south-east.

Thunder occurred only in Orkney and Shetland,—on 21st.

Coast fog occurred at times, and sunshine amounts were deficient in the north, but elsewhere mostly equal to or above the average.

APRIL.

During the first three weeks of the month winds from north-west or west-north-west were rather frequent, and temperature, as a rule, reached only a moderately high level. Towards the end of that period, however, there was a fairly well-defined temperature excess in eastern districts, with highest readings for the month here and there at coast stations on 19th. During the last week, when an easterly type of weather prevailed, with a considerable amount of sunshine, fairly warm days alternated with rather cold nights, and at various places the extreme readings of the month occurred within a few hours of one another. Thus on the night of 28th-29th a minimum reading of 28° at Perth was registered between two days on which

temperature rose to 67° and 68°. Highest readings occurred very widely on 28th or 29th, two or three stations reaching 70° and Fort William 73°. The lowest reading reported was 21° at Leadhills on 8th.

In several eastern districts the month was almost continuously dry, and various places had quite nominal falls—*e.g.*, Marchmont, with only 0·56 inch, or just one quarter of the normal. Outside this area there was in general an excess, and towards the north-west the excess was very large. Thus Fort William, Fort Augustus, and Inverness had about twice the normal, and Poltalloch, Inveraray, and Glencarron an excess of 70 per cent or more. Heavy to fairly heavy falls were more or less general from 2nd to 4th, and again from 6th to 8th, especially towards north-west. Thereafter the most general rains occurred on 10th, and on 18th and 19th, when there were again large amounts in north-west, as much as 3·35 inches at Kinlochquoich on 18th. About 20th a period of generally deficient rainfall, which was to prove of considerable persistence, had set in in nearly all districts, and at Fort William more rain fell on 18th and 19th April than during the whole of May and June together. Falls experienced rather widely on 30th were only trifling to moderate.

Rather stormy weather occurred early in the month in the north, and very generally around 8th, 16th, and 18th. In various districts there were slight falls of snow and hail.

Thunder occurred very locally in the north on 3rd and 4th; in Ayrshire on 7th or 8th; and here and there on 30th.

Sunshine aggregates were equal to or slightly above the normal in the south, but increasingly deficient towards the extreme north.

Coast fog occurred in the west around 11th, and somewhat widely between 23rd and 29th.

MAY.

Very considerable fluctuations of temperature were experienced, but with frequent winds from east and north-east,—the accompaniment of an unusually high barometric pressure over Scotland,—the mean temperature of the month was decidedly below the average in east and north, though practically equal to it in some western districts. Cold weather during the first two or three days was followed by a mild spell until 10th. On 11th a very cold easterly to north-easterly type of weather set in, lasting until about 20th, with lowest readings for the month from 13th to 15th; and for the week ending 15th the mean temperature was in various districts 6° or more below the normal. On night of 13th-14th the thermometer in screen fell to 20° at Braemar, with a reading of 14° from a thermometer

exposed on the grass. From 21st or 22nd to 25th warm days were experienced though easterly winds still prevailed, and on 24th Gordon Castle and Fort William reached 80°. The closing days of the month were much colder, and ground-frost occurred in various districts around 28th.

The month was a dry to very dry one in all districts, and at many places the quite moderate aggregates were largely accounted for on a single day, the 11th, when more or less heavy falls were general. Earlier in the month slight falls on 1st had been followed by a dry spell until 9th and 10th, broken here and there on 6th; whilst from 12th to 27th rainless or all but rainless weather was experienced in various districts, though with rain here and there on 12th, 19th, and 20th. Moderate to heavy falls occurred widely on 28th and 29th, and in north-west on 31st. For the whole month only a few isolated places had as much as 2 inches of rain; large areas had less than 1½ inches; numerous stations less than 1 inch; and Oban only 0·47 inch. Relatively to the normal the shortage was least pronounced towards the south-east, whilst a great part of the country had less than one-half the normal, and some north-western districts less than one-third.

There was a touch of wintry weather around 13th, with snow at places,—about 1 inch at Edinburgh.

Thunderstorms occurred locally towards north-east and south-east on 6th; in some Border districts on 7th; and at one or two points on 29th.

The month was a very sunny one, especially towards the west and north-west. Castlebay (Barra), with an average daily amount of 9·45 hours, and Oban (8·77 hours) were the sunniest stations in the British Isles.

Coast fog occurred here and there about 6th and 7th, and somewhat widely between 21st and 25th.

JUNE.

The first few days of the month were in general cold and cloudy, with a little rain on 1st, 2nd, and 4th, but there soon developed a remarkable spell of settled weather covering a period of about three weeks. During this spell the barometer remained at a high level; large amounts of sunshine were recorded; and there were persistent easterly winds of no great force. The nights were, as a rule, cold, with rather destructive ground-frosts at times in both England and Scotland; whilst day temperatures were high until the middle of the month in north and east, with maxima on 12th, when Arbroath reached 81°, and in west and south until about 23rd. The last week was rather cold in all districts, and in north and east there was

about the middle of the month a sharp fall in temperature from which there was no recovery. Lowest readings occurred nearly everywhere on night of 17th-18th, when the thermometer in screen at Braemar fell to 27° , with a reading of 19° on a thermometer exposed on the grass.

From 5th to 25th some districts were absolutely rainless, and in none was there rain of any importance except during the first two or three days or the last two or three days of that period. In some northern districts there was a practically continuous drought from 5th onwards. On the afternoon of 26th heavy rain set in, except in some northern and southern districts; and on 29th, and less widely on 30th, falls of considerable intensity occurred locally during thunderstorms. Here and there, as at Paisley, the month's aggregates slightly exceeded the normal, but in general there was a very decided shortage, moderate in some eastern districts, but as a rule seriously acute, especially towards the north and north-west, where Dunrobin (0.46 inch) and Glencarron (0.91 inch) had less than one quarter of the normal. A considerable area in the north, and various points in east and south, had aggregates of less than 1 inch.

The thunderstorms of 29th and 30th were widely experienced, though not in northern districts, and flooding occurred here and there on these days. There were minor thunderstorms at a few places on 27th and 28th, and one of considerable intensity at Aberdeen and in Shetland on 8th.

In spite of rather cloudy weather at the beginning and end of the month, sunshine amounts were much above the normal. Between 9th and 22nd there were many days of continuous sunshine, and for the week ending 19th, Gordon Castle, Aberdeen, and Stornoway, with an average of $13\frac{1}{2}$ -14 hours per day, appear to have been the sunniest places in the British Isles. It is extremely rare in Scotland for both May and June to rank as very sunny months, and at Edinburgh the May-June period was the sunniest since 1911, and at Glasgow much the sunniest for at least thirty-five years.

Coast fog occurred somewhat widely from 26th to 30th; and here and there around 7th and 12th.

JULY.

The weather of July was almost continuously of an unsettled type, and in marked contrast to that which had prevailed during most of May and June. The average level of the barometer was lower than in any July since 1888, and though the month opened with fairly warm weather, there was for the most part a notable absence of the high day temperatures appro-

priate to midsummer. With winds at times from east and north some decidedly cold weather occurred during the latter half of the month, though there was a recovery of temperature in the west during the last day or two. On both 26th and 27th the temperature at Braemar fell to 34° ; and the highest reading reported was 75° at Carnoustie on 3rd. For Scotland as a whole the month was the coldest July since 1910.

With rather frequent thunderstorms there were various rain-falls of great intensity, but these were often very local in character. The generally wettest period was from 18th to 26th, but amounts of 1 inch or more within twenty-four hours occurred in north-east and south-east on 7th; at places on 14th; in Argyllshire and elsewhere on 18th; at Greenock on 19th; in parts of the Spey valley and extreme north on 24th; and at Fortrose and Dunrobin on 28th. In many districts little or no rain fell on 4th and 5th; from 7th to 10th; and during the last three or four days of the month. In the Orkneys and extreme north the aggregate rainfall was below the normal, as was the case in parts of Perthshire and of the West Highlands, and here and there elsewhere. At many places there was only a trifling excess, but at Nairn the month's rainfall was more than twice the normal, and at Kingussie nearly twice. In various districts the month was the wettest July since 1910. At some eastern stations more rain fell than during the whole of the three preceding months. At Banff the total of 4.28 inches, compared with an aggregate of 3.23 inches for the April-June quarter; and during the twelve-hour period commencing at midnight on 24th as much as 1.63 inches of rain fell, or more than had been recorded during the whole of May and June.

As already noted, thunderstorms were rather frequent. Visitations on 26th and 27th were severe and fairly general, with flooding in places and heavy hail. Earlier in the month thunderstorms had occurred more locally on 1st; at Edinburgh and elsewhere on 4th; on 5th; from 13th to 15th; and on 22nd and 23rd. At various places thunder or fully developed thunderstorms occurred on five or more days.

Sunshine amounts were below the normal in the north; about equal to the normal towards the south-east; and above it in the west. As a rule, the duration averaged about 2 hours per day less than in June.

AUGUST.

The unsettled conditions of July persisted in various districts throughout the first half of August, and the month was notable for a remarkable series of thunderstorms,—towards the Borders on 2nd; at Edinburgh, Perth, and elsewhere on 4th; over wide

areas on 12th, 13th, and 14th,—at Edinburgh on each of those days; and less widely on 11th and 15th. These thunderstorms were frequently accompanied not only by rain but by heavy hail, and in their greatest intensity were, as a rule, very local in character. Remarkable flooding occurred at times, especially at Carstairs on 2nd. Various very heavy falls in short periods were reported,—as much as 1·75 inches in an hour at Biggar on afternoon of 2nd; nearly 1 inch in 40 minutes at Edinburgh on afternoon of 4th; and as much as 2·30 inches at Turnberry during the afternoon of 12th. Following this very unsettled spell, fine conditions prevailed from 16th to 27th, except in extreme north-west, followed by rather heavy falls in the east on the 28th and 31st.

The month's aggregate rainfall was above the normal in the Upper Spey valley, over a small part of Perthshire and Forfarshire, and in Fife, Mid-Lothian, and East Lothian; but deficient elsewhere, and in the extreme north and extreme south-west only about one-third of the normal. At Wick the aggregate was less than 1 inch. In the Edinburgh area (7·05 inches at the University) amounts were more than twice the normal, and during the last 100 years a wetter August has been experienced in Edinburgh only in 1877 (8·33 inches). The region of very excessive rainfall did not extend far inland, and at Balerno (Cockburn Hill) the month's total was hardly more than 3 inches.

The first week of the month was rather cold in east, but fairly warm in west and south, with maxima at Oban and a few other stations on 2nd. The second week was in general warm and sultry; the third rather cooler; and the fourth warm and sunny, and in some eastern districts the warmest of the summer. During the last three days there was a sharp drop in temperature, with minima for the month at that time, slight frost here and there, and low day readings for the time of year. At Braemar and West Linton on night of 30-31st the thermometer in screen fell to 30°. The highest reading reported was 76° at Balmoral on 25th, and at Logie Coldstone on 27th.

Sunshine amounts were in general below the normal.

Fog occurred around the north of Scotland from 11th to 15th, and at various points of our coasts on 9th and 10th.

SEPTEMBER.

After a few days of cold weather, with the thermometer as low as 27° at West Linton on 4th, there developed a more or less continuous spell of warm, sunny days, with highest readings for the month in almost all districts between 7th and 10th. The nights, however, were cold at times. Towards

the end of the month cold winds from some northerly or easterly point prevailed, and during the last three days both days and nights were cold, with exceptionally low minima in southern districts. The lowest reading in screen was 24° at Kilmarnock on 29th; on that day the maximum temperature at Aberdeen was only 47° ; and on night of 27th-28th the temperature on grass at Dumfries fell to 25° . The highest temperature reported was 78° at Logie Coldstone on 8th.

As regards rainfall, except for heavy rains in Edinburgh and towards the south-east on 1st, the month pursued a quite uneventful course until 24th. Over considerable areas practically no rain fell during the first two weeks, and after rather unsettled conditions around 16th and 17th the weather was again fine for some days. On 24th a small barometric depression developed over the south of England, increasing in intensity as it moved on an almost northerly track. On the morning of 26th its centre lay off the north-east of Scotland, and then moved abruptly eastward. This depression was associated with heavy to moderate rains over a large part of the country on 24th,—nearly $1\frac{1}{2}$ inches at Edinburgh; but in the north there were but trifling falls. On 25th, however, with a very strong wind from north-north-east, abnormally heavy rains set in towards the north, and within twenty-four hours the whole of the catchment area of the Spey and the regions to the west and north of that area had received more than 1 inch of rain, many districts more than 2 inches, and many places 3 inches, 4 inches, or even more. On 26th there were again considerable falls over a more limited area. Thereafter conditions remained unsettled in the north, whilst in the south fine weather was experienced from 25th onwards. At Nairn a fall of 3·78 inches on 25th was almost twice the heaviest daily rainfall previously recorded there during the past fifty years, and 1·69 inches was registered on 26th; and on 25th, Fortrose had as much as 4·07 inches, and Dalcross Castle reported the extraordinary fall of 7·06 inches. At Nairn the month's aggregate was nearly thrice the normal, and in some well-defined districts there was a large excess, but over a large part of the country there was a pronounced shortage. Considerable areas in west and south had only one-third or less of the normal, and some stations had less than 1 inch,—Ardwell House, in Wigtownshire, only 0·53 inch.

The heavy rains of 25th and 26th caused disastrous flooding in the counties of Banff, Moray, Nairn, and Inverness, and in districts farther north. On the Highland Railway there was great interruption of traffic; many bridges and culverts were carried away, and crops destroyed by the inundation of agricultural lands. In the Spey valley and adjoining regions the

floods challenged comparison with the historic "Moray Floods" of 1829, and at Elgin the river Lossie rose to within 4 inches of the high-water mark of that year. The rains were accompanied by a gale from north-north-east which did great damage at Buckie harbour and elsewhere.

Thunder occurred at one or two places on 2nd and 13th, and a thunderstorm at various points in south and south-west on night of 24th-25th.

Sunshine amounts were above the normal, and considerably above those for August.

OCTOBER.

The cold weather which had characterised the last few days of September persisted during the first week or so of October, with lowest readings for the month in some districts at that time,—as low as 22° at Braemar on 6th. A spell of genial conditions, with temperature considerably above the normal and with a fair amount of sunshine, followed, with highest readings for the month between 13th and 16th; but from about 23rd onwards the weather was of a cold south-easterly type, with lowest readings in various districts between 26th and 30th. The extremes reported were 65° at Gordon Castle on 13th and 21° at West Linton on 30th.

The first few days were rainless, or all but so, in practically all districts, and in some no rain of much importance fell until 23rd. Around 8th, 11th, and 17th, however, moderate to rather heavy falls were experienced in some districts. On 23rd heavy to very heavy falls occurred, except in north, north-west, and extreme south-east,—more than 2 inches at Whithorn and elsewhere in the south. On 27th considerable falls were again experienced somewhat widely, followed by some extremely heavy falls in east and north-east on 28th,—as much as 3·34 inches at Crathes (with about 1 inch on 27th), and about 2½ inches at Fyvie Castle and Lednathie. Conditions were generally fair during the last three days of the month, though still unsettled here and there towards north-east. As a result of very heavy falls on two or three days, the month's aggregates were considerably above the normal in some hilly eastern districts; but much the greater part of the country had a rainfall below the normal, and in north, north-west, and extreme south-east the shortage was acute. The areas of excess were very clearly defined, as were those visited by the heavy rains of 28th. Thus the rainfall at Crathes on 28th was considerably more than the month's total at Aberdeen, less than twenty miles away, and practically equal to that at Fort William for the whole month.

Around 28th the weather was stormy, with a south-easterly gale in some districts, and on the morning of that day H.M.S.

Argyll was wrecked "off the east coast of Scotland." Earlier in the month wind force was high at times.

A thunderstorm occurred on evening of 11th in some western districts; and at Arbroath early on 31st.

Sunshine was much above the normal towards the extreme north; about the normal in the east; and deficient in some western districts. Fortrose, Nairn, and Gordon Castle, with an average of more than four hours per day, enjoyed more sunshine than any other places in the British Isles, and about $1\frac{1}{2}$ hours per day more than, *e.g.*, Bournemouth.

A good deal of fog occurred in Firth of Forth from 2nd to 7th, and from 14th to 17th, but little elsewhere.

NOVEMBER.

Moderately high temperatures occurred around 6th and 7th, but the weather was for the most part extremely cold, and on 15th a frost of great intensity set in and persisted with but slight interruptions until the end of the month. The mean temperature of the third week was below the normal at various places by fully 10° , and at Glasgow by 14° ; and on night of 17th temperature in screen at Balmoral and Braemar fell to 10° , with a reading of 3° at Braemar from a thermometer exposed on the grass. Abnormal cold was experienced in all parts of our Islands, and judged by the mean temperature the only November comparable for very many years was that of 1910. Much lower absolute minima have, however, frequently been recorded in November—*e.g.*, zero at Braemar in 1912. The highest reading was 56° at Inverness, St Andrews, Kirkcaldy, and Thorntonhall, and some higher reading than this has been recorded in Scotland in every November during the last fifty years except in those of 1878 and 1910.

Many districts, except in extreme north and extreme south-east, were rainless or nearly so until 6th or 7th. On 8th moderate to heavy falls were general,— $1\frac{1}{2}$ inches at Poltalloch and Lochbuie; and on 9th very heavy falls, partly accounted for by snow or sleet, occurred over wide areas towards the north of Scotland,—more than 2 inches at Grantown and elsewhere in the Spey valley, and at Balmoral and Braemar. In the north-east there were rather heavy falls again on 10th. On 15th a heavy snowfall occurred rather widely, but in some eastern districts there was practically no precipitation from 13th to 27th or 29th, and nearly everywhere none from at least 16th to 26th. Unsettled conditions were general during the last three or four days of the month, with some rather heavy falls on 29th,—as much as 2 inches at Lednathie. In some northern districts the month's aggregates were above the normal; but

elsewhere there was a moderate to considerable deficiency, and Fort William had less than one-third and Edinburgh less than one-half of the normal.

From 9th to 13th the weather was stormy, with snow and sleet at times, and in northern districts there was serious damage from flooding. In Shetland a gale was continuous for about five days. The snowstorm of 15th was experienced in all except some eastern districts, and was followed by a spell of dry and fine weather, during which snow lay on the ground for a considerable time.

A thunderstorm occurred in Orkney late on 7th.

Sunshine amounts were, as a rule, a little above the normal, but hardly equal to it at Aberdeen and Deerness.

During the settled spell of weather after 15th dense fog occurred over the Clyde area on several days, and there was fog in the Firth of Forth almost continuously from 16th to 21st. At many points on our coasts no fog occurred during the month.

DECEMBER.

Early in December cold and wintry weather occurred, and in general the thermometer remained at a low or rather low level until about the end of the third week. There then set in a spell of extremely mild weather, with highest readings of the month almost everywhere on 31st, and that day was in many districts the warmest day for seven or eight weeks. The highest reading reported was 54° at Greenock and Hamilton. During the cold period lowest readings occurred about 4th or 9th, but here and there on 19th,—as low as 9° at Kingussie on 4th, and 8° at Balmoral on 5th. The mean temperature of the month was in most districts below the normal, but distinctly above the mean for the very cold month of November.

As regards rainfall, many districts were rainless during the first three or four days of the month, but on 5th heavy falls, partly due to melting snow, were more or less general, and thereafter conditions were mostly unsettled, with many wet days nearly everywhere. Falls exceeding 1 inch occurred towards north-east and south-east on 5th; towards north-west on 7th; in some western districts on 10th,—as much as 3 inches at Lochbuie, in Mull; at places on 22nd, 24th, and 27th; and rather widely on 31st. In northern, eastern, and southern districts the month was a very wet one, though more remarkable for the persistence of precipitation than for any notably heavy individual falls, and considerable areas had more than twice the normal. At Ardross Castle, in Ross-shire, the total of 8.60 inches exceeded that of any other December in a record going back to 1866; at Dundee the month was the wettest

December since 1876; and at Edinburgh the wettest since 1891. In many of the wet districts, however, December 1914 was a wetter month. The month's aggregates were, however, below the normal at Greenock, Buchlyvie, Stronvar, and in the West Highlands.

Much stormy weather occurred, as a rule of an easterly to south-easterly type, and more particularly between 5th and 12th, from 22nd to 25th, and during the last day or two of the month. There was damage to shipping on the East Coast about 6th and 24th, and a gale was practically continuous in the north-east from 23rd to 25th. Snowstorms occurred around 4th and 9th, with some snow, sleet, and hail at other times. On 4th the snow gave place to heavy rain followed by flooding in some districts.

A thunderstorm occurred towards north-east on 12th.

Sunshine was deficient in east and north; about equal to the normal in the west.

There was much fog at times over the Upper Clyde area; but little coast fog occurred, except in the Firth of Forth from 14th to 20th.

General Note.

In east, north-east, and some central and northern districts the year's rainfall was equal to or somewhat above the normal; but regions of excess were accounted for by a few very wet days and two or three wet periods, and an outstanding feature of the year was the large amount of dry weather which occurred. In the extreme north, and in western and most southern districts, there was a well-defined shortage, and towards the north-west the shortage was of a most decided character. In West Inverness-shire the year was the driest on record. At Fort William the rainfall was 30 per cent below the normal, and three-fifths of it was accounted for before the end of April; every month from May onwards had a shortage; and May, June, September, October, and November had each less than half the average amount of rain. Outside the north-western area the extreme south-west appears to have been the region most notable for the persistence of dry periods.

The severe frost of November seriously interfered with agricultural operations.

RAINFALL RECORDS FOR 1915 IN INCHES.

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Shetland—Lerwick . . .	4.76	4.53	3.75	3.31	1.46	1.22	3.70	2.32	1.34	1.73	4.13	5.35	37.60
Orkney—Deerness . . .	3.87	4.04	2.32	2.34	.57	.57	1.94	1.71	2.58	1.06	3.90	6.66	31.56
Caithness—Wick . . .	2.32	2.52	2.05	2.32	.51	.37	2.52	.87	3.39	1.06	3.78	4.44	26.65
Sutherland—Tongue . . .	3.63	3.70	3.32	3.18	1.48	.87	4.38	3.08	6.06	1.27	4.15	7.32	42.44
Dunrobin . . .	3.12	3.31	2.89	3.09	1.08	.46	4.43	1.02	2.15	1.50	4.32	5.35	32.72
Ross and Cromarty—													
Fortrose . . .	1.70	1.98	1.89	2.61	1.12	.96	4.00	2.26	6.41	1.44	3.33	3.85	31.58
Strathpeffer . . .	2.42	2.93	2.14	4.05	.67	.71	4.30	1.99	2.65	1.89	3.11	4.33	30.19
Glencarron . . .	11.60	6.16	8.63	9.17	1.31	.91	4.73	6.47	4.62	2.19	4.93	7.69	68.31
Stornoway . . .	7.54	5.87	4.13	3.59	1.20	1.18	2.87	2.16	3.14	1.86	5.14	6.97	46.05
Inverness—Inverness . . .	2.26	1.74	2.51	3.11	1.15	.56	2.99	2.21	5.06	.24	2.61	3.35	27.79
Grantown . . .	2.94	2.53	3.26	2.68	1.39	.68	4.23	2.62	4.11	1.46	4.44	4.63	35.17
Glenquolch . . .	13.52	11.23	8.01	12.09	1.77	2.29	5.92	6.14	3.47	3.03	5.97	12.22	85.66
Fort William . . .	10.18	7.26	5.80	7.64	1.05	1.50	4.18	3.18	2.30	3.40	2.51	6.12	54.62
Nairn—Nairn (Delnias) . . .	1.89	1.35	1.73	2.21	1.26	.65	5.74	1.30	6.75	.01	2.68	3.27	29.74
Elgin—Gordon Castle . . .	2.47	2.93	3.47	2.24	1.26	.71	4.34	3.16	5.75	1.88	4.04	5.15	37.40
Banff—Craigellachie . . .	3.08	3.39	3.99	2.29	.77	.65	4.71	1.89	6.96	1.73	5.80	5.05	40.81
Aberdeen—Fyvie Castle . . .	4.70	5.17	3.07	1.65	.75	1.56	4.44	1.86	3.24	5.02	4.41	8.47	44.84
Peterhead . . .	3.00	2.76	2.49	1.43	.60	1.12	5.33	1.47	2.99	2.14	4.77	6.69	33.83
Aberdeen (King's Coll.)	3.31	3.54	2.14	1.14	.87	1.42	4.29	1.57	2.80	2.65	2.74	5.98	32.45
Balmoral . . .	3.22	4.80	1.85	1.86	1.25	1.43	3.48	3.17	3.42	4.93	4.86	4.82	33.50
Kincardine—The Burn . . .	3.39	3.37	1.76	.82	1.06	.37	5.21	2.76	1.53	5.96	3.44	8.02	40.18
Forfar—Montrose . . .	2.63	4.52	1.22	.62	.89	.69	4.61	2.42	1.66	3.13	1.59	6.10	30.66
Dundee . . .	1.94	4.48	1.43	.84	.96	1.70	3.44	3.67	1.19	2.05	1.69	6.10	29.99
Forfar . . .	2.77	6.67	2.11	.59	.83	1.28	3.03	2.68	1.11	5.28	2.01	7.89	36.25
Lednathie . . .	3.68	8.70	1.73	1.59	.98	1.02	4.24	2.98	1.75	7.44	4.06	10.62	43.74
Perth—Perth . . .	2.22	5.19	1.25	1.17	1.38	1.84	2.33	4.80	1.86	7.54	1.92	6.27	32.77
Crieff . . .	2.65	7.32	1.59	1.69	1.69	2.08	2.85	4.29	1.83	4.17	2.88	6.45	35.99
Killin . . .	5.52	10.44	3.16	5.19	1.39	1.71	3.52	3.50	2.62	4.05	2.17	6.76	44.84
Stronvar . . .	6.19	11.89	3.07	4.83	1.85	1.76	3.85	4.13	3.15	4.23	3.43	7.44	44.84
Aberfoyle . . .	3.90	9.40	5.20	3.90	1.65	1.65	3.85	3.35	1.75	3.20	3.75	7.95	38.55
Fife—St Andrews . . .	1.90	4.93	1.51	.63	.86	1.41	3.10	3.46	2.28	3.57	1.69	6.09	31.47
Kinross—Loch Leven . . .	1.93	5.17	1.62	1.63	1.54	2.30	3.17	3.19	2.07	3.73	2.39	6.99	35.73
Clackmannan—Alloa . . .	1.69	5.52	1.50	2.10	1.47	1.71	3.42	4.17	2.04	4.06	2.31	5.52	35.51
Argyll—													
Lochbuie (Mull) . . .	13.06	7.39	7.78	7.90	1.42	2.04	9.48	8.25	3.02	4.23	4.93	12.07	76.57
Oban . . .	9.04	5.44	3.86	4.81	.47	1.72	5.47	1.54	1.25	2.16	3.26	6.10	45.12
Taynuilt . . .	7.72	9.51	4.66	6.38	.95	1.99	5.91	3.29	1.70	3.66	2.99	7.98	56.76
Inveraray . . .	7.72	9.53	4.83	6.48	1.06	2.12	6.86	3.05	2.12	3.05	3.18	5.35	55.34
Campbeltown . . .	4.11	5.92	2.35	2.66	1.89	1.82	3.02	2.09	.88	4.56	3.56	7.22	40.63
Bute—Rothesay . . .	4.75	6.35	3.26	4.06	1.29	2.70	4.54	3.07	1.62	3.37	2.81	5.85	43.66
Stirling—Buchlyvie . . .	2.72	5.39	2.26	3.88	1.61	1.98	4.75	3.62	2.13	2.93	2.93	4.70	39.40
Falkirk . . .	2.02	3.99	1.91	2.16	1.56	2.01	3.67	3.98	1.90	3.00	1.82	5.27	33.28
Dumbarton—Dumbarton . . .	3.26	7.94	2.67	3.74	1.39	3.02	3.27	2.29	1.22	3.17	3.12	5.49	40.68
Renfrew—Greenock . . .	5.60	10.55	3.91	4.69	1.85	2.15	4.12	2.10	1.61	3.55	3.22	6.44	49.88
Paisley . . .	2.74	5.66	1.77	2.74	1.40	2.58	3.10	1.99	1.22	2.61	2.67	5.73	34.21
Ayr—													
Kilmarnock (Ag. Col.) . . .	3.62	4.95	1.80	2.76	.80	2.01	4.12	2.87	1.12	2.05	1.69	4.74	32.53
Knockdon . . .	4.00	4.59	1.54	2.27	1.00	1.10	4.00	2.00	1.39	1.75	1.42	6.29	31.36
Turnberry . . .	3.00	3.68	1.15	1.99	.88	1.09	3.08	3.26	.86	1.80	1.21	4.00	25.95
Pinnore . . .	6.55	8.48	2.45	3.79	1.70	1.00	8.89	1.66	2.16	4.06	1.88	7.17	44.79
Lanark—													
Glasgow (Observatory) . . .	2.26	4.15	1.17	2.18	1.77	2.08	3.72	2.00	1.33	2.77	1.97	5.54	30.94
Hamilton . . .	1.94	4.19	1.23	2.43	1.23	1.60	3.10	2.79	1.28	1.93	1.55	3.84	27.11
Lamington . . .	2.66	6.01	1.45	1.97	1.27	1.12	3.62	2.68	1.32	1.54	1.90	4.72	30.32
Leadhills . . .	6.24	12.87	5.37	4.65	1.69	2.12	7.73	5.86	1.65	3.58	3.38	9.73	64.87
Linlithgow—Boghead . . .	2.43	3.00	1.70	2.47	1.67	1.79	3.83	3.97	1.80	1.87	1.72	5.00	31.25
Mid-Lothian—													
Edinburgh (University) . . .	1.18	2.15	1.92	1.23	1.57	1.69	2.78	7.05	2.69	3.27	.95	4.45	29.93
Balerno (Cockburn Hill) . . .	2.19	3.39	2.09	2.16	1.67	2.11	5.09	3.18	2.35	2.41	1.65	6.27	34.56
Haddington—													
Gullane . . .	1.50	1.80	1.21	.97	1.30	1.50	3.71	5.57	2.86	2.21	1.46	3.98	28.07
Donolly (Reservoir) . . .	1.85	3.83	2.58	1.01	1.49	1.98	4.35	2.94	3.10	2.20	2.30	3.75	31.38
Berwick—Marchmont . . .	2.28	2.94	2.18	.56	1.67	1.52	4.67	3.35	2.50	2.64	2.66	6.75	39.57
Peebles—Glen . . .	4.23	6.85	1.76	2.49	1.53	.78	3.19	3.55	2.42	2.62	2.40	7.04	38.76
Selkirk—Selkirk (The Hangingshaw) . . .	2.27	4.06	2.71	1.11	1.74	.95	3.12	2.80	1.79	2.22	1.50	7.57	31.84
Roxburgh—													
St Boswells (Fens) . . .	1.47	2.27	2.02	.70	1.28	1.97	2.77	5.47	1.53	1.45	1.66	5.13	27.73
Braxholme . . .	1.64	4.93	1.97	1.31	1.67	2.04	3.50	3.00	1.84	1.18	1.44	5.42	30.22
Dumfries—Dumfries . . .	2.35	7.54	1.08	2.31	1.46	.80	2.75	2.15	1.01	3.14	2.03	6.40	39.82
Drumlanrig . . .	4.76	9.12	2.04	2.88	1.87	1.78	4.03	3.65	1.54	3.19	2.58	7.53	44.85
Kinnelhead (Beattock) . . .	4.71	8.84	2.16	3.69	1.56	1.17	4.73	2.76	1.82	3.14	3.85	8.95	46.90
Langholm . . .	3.14	9.46	3.02	3.66	2.15	2.50	5.22	2.37	1.54	2.18	2.90	8.58	46.13
Kirkcubright—Cargen . . .	3.63	11.10	1.90	3.40	1.59	.65	3.84	2.70	1.18	4.08	3.86	8.77	45.65
Dalbeattie (Lit. Richorn) . . .	3.25	7.66	1.63	2.92	1.63	.86	4.98	3.08	1.27	5.18	3.28	8.99	45.52
Cassidair (Shiel) . . .	7.89	13.80	2.78	4.73	1.65	1.34	3.93	3.60	2.47	6.01	4.98	10.45	63.28
Wigtown—Galloway Hse . . .	3.49	4.44	1.76	1.85	1.40	.90	3.30	.58	.59	2.84	1.86	6.61	29.97

AGRICULTURAL STATISTICS.—RETURNED UPON 4TH JUNE 1915—(Compiled from the Government Returns).

TABLE No. 1.—ACREAGE UNDER CROPS AND GRASS IN EACH COUNTY OF SCOTLAND.

COUNTIES.	CORN CROPS.										Other crops.																																		
	Total Acreage under Crops and Grass.*		Arable Land.		Permanent Grass.		Wheat.		Barley, including Brev.		Oats.		Rye.		Beans.		Peas.		Total.		Potatoes.		Turnips and Swedes.		Mangels.		Cabbage.		Rape.		Vetches or Tares (Seed).		Vetches, Tares, Ma.illum, &c. (Podder).		Small Fruit.		Rye-grasses and other Tallion Grasses and Clover.		Other crops.		Bare Fallow.				
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.		
1. Aberdeen . . .	626,646	591,449	55,197	58	16,904	194,564	68	191	211,791	7,211	84,131	10	123	57	168	2,847	23	284,284	298	305	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294
2. Antrim . . .	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	
3. Argyll . . .	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	130,595	
4. Banff . . .	185,853	143,682	172,102	1,597	8,334	41,912	92	823	10	44,678	9,822	7,111	510	253	181	1,747	216	79,297	182	642	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216
5. Barr . . .	158,853	143,682	172,102	1,597	8,334	41,912	92	823	10	44,678	9,822	7,111	510	253	181	1,747	216	79,297	182	642	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216
6. Berwick . . .	191,261	137,238	11,054	8	5,694	50,632	44	65	32	5,355	1,817	8	18	136	784	15	46,414	8	129	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	
7. Breck . . .	25,214	14,599	10,815	2	9	33,128	36	42	9	63,089	24,227	24,227	133	29	62	448	29	56,019	4	35	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
8. Bute . . .	169,573	81,867	27,708	559	108	30,828	36	42	9	4,750	1,241	9	20	95	1	274	43	7,294	16	166	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	
9. Caithness . . .	15,499	8,626	6,473	559	108	30,828	36	42	9	4,750	1,241	9	20	95	1	274	43	7,294	16	166	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	
10. Dumfriesshire . . .	253,118	134,859	118,249	1,006	33	6,559	14	226	8	31,615	1,441	12,050	143	9	34	574	8	96,165	16	166	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
11. Dundee . . .	123,017	78,005	44,112	7,892	1	21,245	6	28	5	42,738	3,815	16,055	11	117	64	8	44	70,856	54	45	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	
12. Edinburgh . . .	98,987	90,984	8,003	7,892	1	21,245	6	28	5	42,738	3,815	16,055	11	117	64	8	44	70,856	54	45	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	
13. Elgin or Moray . . .	247,729	172,174	75,555	15,239	18,828	43,405	364	12	35,660	1,802	14,002	27	7	4	70	252	23	39,087	92	63	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	
14. Forfar . . .	247,729	172,174	75,555	15,239	18,828	43,405	364	12	35,660	1,802	14,002	27	7	4	70	252	23	39,087	92	63	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
15. Haddington . . .	111,935	89,890	22,075	8,249	11,940	18,858	774	47	23	87,748	17,009	31,887	20	129	42	95	454	352	82,980	139	49	352	352	352	352	352	352	352	352	352	352	352	352	352	352	352	352	352	352	352	352	352	352	352	352
16. Inverness . . .	147,906	85,662	61,644	312	5,595	29,818	865	8	149	118	39,069	8,664	13,986	380	412	171	7	139	321	26,170	821	60	321	321	321	321	321	321	321	321	321	321	321	321	321	321	321	321	321	321	321	321	321	321	
17. Kinross . . .	119,122	108,757	10,365	1,416	16,140	29,786	81	20	8	9,703	3,784	15,677	3	12	10	23	482	81	46,888	55	64	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	
18. Kirkcudbright . . .	84,095	14,679	14,416	226	218	6,447	80	1	1	4,481	1,42	2,994	3	24	35	6	41	9,269	2	23	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	
19. Lanark . . .	186,691	88,546	63	134	25,219	40	18	18	12	25,464	1,736	10,481	18	693	73	503	1,087	49,571	25	144	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	
20. Leith . . .	249,556	125,634	125,634	3,034	205	32,457	25	119	12	40,882	6,374	9,438	18	693	73	503	1,087	49,571	25	144	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	
21. Linlithgow . . .	57,212	83,375	23,372	8,158	1,685	10,575	9	74	14	15,515	2,620	3,159	12	84	158	21	149	43	10,244	11	42	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	
22. Nairn . . .	25,449	23,216	2,233	49	2,114	6,488	27	3	3	37,024	2,590	13,006	24	1	25	225	2	10,244	11	42	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	
23. Orkney . . .	107,376	90,991	16,385	3	3,608	83,412	3	3	3	37,024	2,590	13,006	24	1	25	225	2	10,244	11	42	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	
24. Peebles . . .	50,385	27,370	23,016	3	3,608	83,412	3	3	3	37,024	2,590	13,006	24	1	25	225	2	10,244	11	42	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	
25. Perth . . .	831,040	223,559	108,381	9,234	5,544	68,477	690	843	20	84,508	16,196	25,337	28	176	461	27	473	60,102	18,802	50	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13		
26. Renfrew . . .	86,706	37,568	49,138	2,361	50	10,415	17	72	11	12,916	3,223	2,037	19	208	51	5	29	102	18,802	50	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13		
27. Ross & Cromarty . . .	139,749	110,978	27,771	2,126	7,807	32,506	38	1	15	42,390	6,497	14,814	25	96	26	135	312	17	46,380	12	265	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17		
28. Roxburgh . . .	177,527	109,665	67,862	789	9,616	29,082	1	139	4	89,631	1,248	19,234	108	109	386	65	184	30	48,341	37	49	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	
29. Selkirk . . .	29,158	15,686	13,472	43	316	4,394	6	6	2	4,761	184	2,874	108	109	386	65	184	30	48,341	37	49	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	
30. Shetland . . .	35,307	14,068	21,239	43	764	6,575	6	6																																					

TABLE No. 2.—TOTAL PRODUCE OF WHEAT, BARLEY, AND OATS, ACREAGE AND YIELD per Acre in the Year 1914, compared with the YIELD for the Years 1913 and 1912, and the AVERAGE of the Ten Years, 1904-1913, in each COUNTY of SCOTLAND.

COUNTIES.	WHEAT.					BARLEY, INCLUDING BEER.					OATS.											
	Total Produce in 1914.	Acreage in 1914.	Yield per acre.				Total Produce in 1914.	Acreage in 1914.	Yield per acre.				Total Produce in 1914.	Acreage in 1914.	Yield per acre.							
			1912.						1913.						1912.				1913.			
			1914.	1913.	1912.	Average of the Ten Years.			1914.	1913.	1912.	Average of the Ten Years.			1914.	1913.	1912.	Average of the Ten Years.	1914.	1913.	1912.	Average of the Ten Years.
Aberdeen	125	33	30.18	33.00	32.50	108,128	23,149	37.37	35.37	35.05	33.94	908,049	185,259	59.22	36.62	37.32	36.31					
Argyll	1	1	16.00	16.00	16.00	6,509	1,439	37.34	37.34	37.34	37.34	74,484	16,444	59.24	36.97	37.32	36.44					
Ayr	5,967	1,039	45.93	47.39	44.36	3,064	633	38.72	41.14	42.43	39.68	242,828	58,865	49.08	47.70	48.63	47.94					
Barr	11,095	2,122	41.82	39.44	36.74	37,258	8,814	38.14	37.37	37.37	35.01	241,128	47,926	40.25	41.01	43.48	43.50					
Berwick	11	1	45.00	44.67	50.09	89,853	19,248	36.67	35.71	35.71	36.21	148,816	30,091	39.83	37.32	38.49	37.62					
Bute	11	1	45.00	44.67	50.09	55	12	37.35	37.35	37.35	36.21	21,002	4,510	37.26	37.03	27.52	31.24					
Caithness	2,960	496	47.74	45.92	44.80	3,331	854	31.20	34.83	36.48	29.67	125,627	31,156	32.26	37.03	27.52	31.24					
Clackmannan	3,325	694	38.33	36.49	37.24	1,043	241	34.63	35.67	37.66	35.62	12,767	2,794	36.55	37.71	41.66	33.19					
Dumfriesshire	370	78	37.90	38.38	38.76	4,831	1,008	38.34	38.41	38.63	37.47	185,654	40,285	36.87	37.08	36.50	34.98					
Edinburgh	40,360	6,672	48.40	47.44	45.29	30,967	5,378	44.41	42.26	41.63	42.94	107,129	18,792	45.75	39.81	45.78	42.33					
Elgin or Moray	2,518	465	45.32	42.39	37.15	50,293	10,804	36.90	37.42	35.28	34.78	131,789	28,434	44.99	44.84	43.07	42.35					
Fife	61,748	12,660	38.99	40.74	34.65	91,864	18,675	39.35	38.38	40.07	37.35	197,450	37,483	42.14	36.42	41.37	38.23					
Forfar	54,285	10,811	40.17	37.68	37.15	120,129	25,593	37.55	36.80	38.59	38.20	292,414	48,016	48.72	47.57	49.39	47.62					
Galloway	33,587	5,677	47.93	44.24	41.50	98,102	16,001	49.05	45.40	44.59	42.52	98,484	15,911	51.46	42.79	49.11	44.52					
Haddington	870	129	41.57	38.45	35.67	21,550	6,452	26.72	31.47	29.61	28.67	115,622	29,514	31.54	32.51	30.78	29.13					
Inverness	5,021	1,044	38.47	37.62	36.20	54,457	11,983	36.86	35.95	35.11	32.78	186,671	26,735	37.50	38.69	40.13	38.56					
Kinross	777	144	48.72	46.36	44.38	41.94	279	57	39.19	40.58	36.48	36.71	109,766	6,134	32.63	30.08	40.13	33.58				
Kirkcubright	14	14	40.00	36.00	33.00	279	57	39.19	40.58	36.48	36.71	109,766	6,134	32.63	30.08	40.13	33.58					
Leith	10,862	2,260	36.50	34.92	36.90	35.22	598	141	33.67	32.65	35.67	32.66	181,523	24,442	35.92	36.65	36.19	36.32				
Leithgow	15,117	2,693	47.18	45.59	43.11	12,153	2,921	32.28	31.28	30.27	28.24	53,079	9,610	42.54	42.54	41.54	43.19					
Midlothian	157	23	38.00	36.00	33.00	15,531	3,767	32.98	33.32	32.41	32.85	137,220	34,705	32.57	32.57	32.57	32.57					
Orkney	..	..	..	..	..	1,936	455	37.02	31.97	34.57	32.44	307,165	64,298	45.73	40.07	36.82	38.07
Perth	89,217	7,665	40.93	38.59	37.98	41,985	8,697	37.79	37.45	37.19	36.59	307,165	64,298	45.73	40.07	36.82	38.07					
Perthshire	5,571	1,997	38.32	44.31	42.68	40.80	159	32	39.69	36.00	36.24	36.45	11,164	9,162	44.62	47.04	40.78	43.13				
Renfrew	9,577	1,997	43.17	40.95	39.82	40,011	10,066	31.72	32.01	30.55	30.43	189,217	29,922	37.22	36.92	38.14	37.73					
Ross and Cromarty	2,673	523	40.37	40.95	39.82	56,604	11,794	38.40	37.60	33.38	33.58	141,529	26,457	42.80	39.36	38.84	37.73					
Roxburgh	44	11	42.00	35.00	33.13	1,655	375	35.31	33.00	31.06	31.72	19,256	4,312	35.73	35.00	33.55	33.52					
Selkirk	..	..	..	..	..	2,498	784	25.49	27.91	21.48	25.64	70,756	6,511	25.40	29.58	23.96	26.62
Shetland	..	..	..	..	..	9,314	1,610	46.03	36.52	43.38	39.24	97,707	16,909	48.83	40.96	39.58	39.15
Stirling	..	..	..	..	..	2,751	644	34.17	35.30	32.64	31.59	32,789	7,745	33.88	31.37	31.37	34.39
Sutherland	..	..	..	..	..	2,528	504	40.13	40.73	44.40	37.15	139,887	30,092	37.18	36.79	45.08	38.61
Wigtown	..	..	..	..	..	922,925	194,106	38.04	37.15	36.00	35.90	4,618,850	919,580	40.18	38.40	38.44	37.63
Total	320,102	60,521	42.81	42.82	38.41	40.21	922,925	194,106	38.04	37.15	36.00	35.90	4,618,850	919,580	40.18	38.40	38.44	37.63				

* Average of 6 years only.

† Crop failed.

§ Exclusive of 3 acres in the County of Argyll (Cowal District), the produce of which was cut green.

TABLE No. 3.—TOTAL PRODUCE OF BEANS, PEAS, AND POTATOES, ACREAGE and YIELD per Acre in the Year 1914, compared with the YIELD for the Years 1913 and 1912, and the AVERAGE of the Ten Years, 1904-1913, in each COUNTY of SCOTLAND.

[illegible]

* Average of 6 years only.
 † Average of 9 years only.

Age of 8 years only.

t or picked green.

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Inclusive of a certain :

† **Exc'**

TABLE No. 4.—TOTAL PRODUCE OF TURNIPS (including SWEDES) and MANGELS, ACREAGE and YIELD per Acre in the Year 1914, compared with the YIELD for the Years 1913 and 1912, and the AVERAGE of the Ten Years, 1904-1913, in each COUNTY of SCOTLAND.

COUNTIES.	TURNIPS AND SWEDES.					MANGELS.					
	Total Produce in 1914.	Acreage in 1914.	Yield per Acre.			Total Produce in 1914.	Acreage in 1914.	Yield per Acre.			Average of the Ten Years, 1904-1913.
			1914.	1913.	1912.			1914.	1913.	1912.	
Tons.	Acres.	Tons.	Tons.	Tons.	Tons.	Acres.	Tons.	Tons.	Tons.	Tons.	
Aberdeen	1,097,442	55,831	12.79	15.99	15.84	18	1	18.00	18.00	10.83	*12.15
Argyll	94,070	5,692	16.53	16.43	15.42	332	22	15.09	15.48	12.02	11.34
Ayr	150,109	7,079	21.20	20.97	20.99	11,647	473	24.02	22.52	21.08	21.10
Banff	225,489	20,984	10.75	17.72	10.23	46	2	23.00	10.71	10.47	10.03
Berwick	382,593	25,092	15.25	17.48	19.72	3,042	175	17.38	14.85	15.51	19.02
Bute	23,107	1,309	17.65	18.26	17.22	247	15	16.47	17.08	16.41	16.67
Caithness	191,057	12,265	15.38	18.04	16.25	..	..	..	..	..	..
Glackmannan	10,187	768	13.28	14.52	15.33	13	1	13.00	10.00	8.00	9.18
Dumfriesshire	28,544	1,331	21.45	21.51	21.37	75	4	18.75	21.00	17.80	17.80
Dumfries	215,594	16,954	12.72	16.19	14.01	5,793	271	21.38	19.32	14.29	16.08
Edinburgh	160,350	9,696	16.54	18.57	18.61	1,126	47	23.96	21.52	20.72	21.29
Elgin or Moray	236,709	14,550	16.27	19.80	18.27	740	30	24.67	19.69	19.15	17.84
Fife	351,942	22,183	15.90	16.80	16.31	508	47	12.09	12.00	9.96	10.80
Forfar	604,137	31,793	19.00	21.31	21.91	355	15	23.67	20.36	21.95	20.05
Haddington	228,825	14,502	15.78	17.4	20.91	19.17	216	24.16	19.09	19.86	20.65
Inverness	136,042	10,005	13.69	14.85	14.29	5,219	3	14.43	13.45	15.83	16.31
Kincardine	205,859	16,102	12.78	15.83	14.90	..	..	..	15.00	15.83	*14.64
Kinross	32,889	2,310	14.24	15.50	16.79	13.91	..	..	..	6.00	7.67
Kirkcudbright	131,910	10,956	12.04	16.17	15.31	2,059	104	19.80	17.91	16.41	19.88
Laonar	199,918	9,489	21.07	18.82	20.20	131	24	6.46	6.38	8.48	8.01
Linlithgow	50,944	3,263	15.43	18.70	19.28	178	6	29.67	26.57	23.29	19.14
Nairn	55,039	3,964	13.82	15.71	16.44	..	..	..	..	14.09	*15.33
Orkney	160,183	13,913	11.51	10.77	10.98	..	..	..	..	..	..
Peebles	66,437	3,507	18.94	19.61	21.23	19.31	..	..	..	..	..
Perth	464,393	25,690	18.08	16.07	19.59	677	33	20.52	15.31	15.38	\$19.20
Renfrew	39,725	2,077	19.13	18.06	20.00	245	14	17.50	17.78	14.87	15.94
Ross and Cromarty	220,533	15,294	14.48	15.80	15.78	409	28	14.61	16.24	16.02	13.18
Roxburgh	207,845	19,794	10.48	16.26	14.42	1,814	74	24.51	22.27	15.92	16.65
Selkirk	23,770	2,493	9.53	13.00	11.44	..	..	..	18.00	12.00	\$16.17
Shetland	12,625	1,044	12.00	13.47	12.27	..	..	..	..	..	..
Stirling	108,551	4,002	27.20	22.72	26.73	285	10	28.50	21.14	25.47	20.29
Sutherland	96,515	2,981	12.25	14.90	15.39	..	..	22.63	21.80	10.00	..
Wigtown	153,150	13,795	11.46	16.50	17.00	7,061	312	22.63	21.80	18.79	19.96
Total	6,311,483	430,608	14.66	16.96	16.81	42,080	1,927	19.84	19.84	17.50	18.39

* Average of 9 years only.

† Crop failed.

‡ Average of 6 years only.

§ Average of 7 years only.

TABLE No. 6.—NUMBER OF HORSES, CATTLE, SHEEP, AND PIGS IN EACH COUNTY OF SCOTLAND AS RETURNED ON JUNE 4, 1915.

COUNTY.	HORSES (including Ponies).				CATTLE.				SHEEP.							
	Used solely for agricul- ture, &c.	Stallions. [†]	Unbroken Horses.		Total.	Cows in Milk.	Cows in Calv. but not in Milk.	Heifers in Calv.	Other Cattle.		Total.	1 Year Old and above.	Under 1 Year.	Total.	Pigs.	
			1 Year & above.	Under 1 Year.					2 Years & above.	Under 2 Years.						
1. Aberdeen	19,906	125	6,025	2,447	2,814	37,989	2,811	2,583	43,195	87,071	173,649	118,933	104,580	292,538	13,293	
2. Argyll	3,789	43	1,190	498	679	18,275	2,266	1,771	10,249	25,843	58,404	585,700	256,089	891,789	5,361	
3. Argyll	6,313	68	1,439	630	1,513	45,015	6,569	8,111	11,351	42,730	114,460	217,113	149,975	367,088	15,697	
4. Argyll	5,643	15	1,645	739	683	11,115	811	757	6,810	25,707	45,200	40,339	29,074	69,413	3,551	
5. Banff	3,661	24	609	173	314	2,552	276	336	3,813	9,874	18,553	164,472	161,170	325,642	3,915	
6. Berwick	815	67	292	67	114	2,844	359	389	1,355	4,512	7,659	26,788	15,489	42,278	397	
7. Buteshire	3,890	27	871	471	334	6,555	604	435	2,014	10,714	21,135	80,482	58,707	139,189	1,919	
8. Caithness	464	9	230	62	68	5,532	141	78	866	1,534	3,229	8,887	7,011	15,898	695	
9. Dumfriesshire	1,773	4	236	120	281	6,137	1,213	785	2,005	4,624	14,704	46,053	29,123	75,176	1,211	
10. Dumfries	4,582	42	1,408	561	1,344	18,225	1,839	4,314	12,006	33,463	70,439	131,568	236,074	554,642	10,663	
11. Edinburgh	3,249	26	490	165	897	4,437	694	532	3,214	5,257	10,417	101,663	76,050	177,693	11,805	
12. Elgin	3,419	8	814	393	402	5,523	334	299	3,710	12,461	22,377	30,004	20,209	50,213	1,912	
13. Fife	6,355	45	1,475	492	1,521	9,958	10,381	1,210	14,034	10,808	47,436	57,830	50,040	107,870	7,108	
14. Forfar	7,037	14	1,122	403	1,125	9,713	9,861	1,215	15,779	19,372	45,436	96,202	69,873	168,075	7,490	
15. Haddington	2,856	12	314	114	374	1,822	105	293	4,153	3,475	9,568	71,759	56,781	128,540	1,898	
16. Inverness	5,915	50	1,317	683	594	8,559	17,601	2,337	5,139	21,343	47,429	340,841	180,083	520,924	1,805	
17. Inverness	3,440	6	777	358	476	4,957	365	334	3,535	12,749	24,138	28,425	19,528	48,953	2,560	
18. Kinross	630	4	225	71	130	1,120	107	155	1,456	3,075	6,833	18,828	14,750	33,578	697	
19. Kirkcubright	3,180	58	1,010	395	815	5,453	10,087	952	4,133	23,906	55,116	227,235	155,862	383,507	13,113	
20. Lanark	5,805	86	1,393	568	1,336	29,113	6,381	4,689	10,389	26,119	77,151	142,697	101,856	244,553	9,587	
21. Leithgow	1,413	14	397	161	289	2,274	3,993	1,754	2,992	4,797	19,594	14,295	8,245	22,541	1,378	
22. Nairn	820	2	242	99	106	1,269	1,338	1,72	600	2,664	6,274	19,003	6,160	18,162	594	
23. Orkney	4,677	30	1,013	700	718	8,952	1,098	826	4,252	17,503	32,684	19,079	18,555	37,634	2,150	
24. Peebles	715	12	104	52	175	1,058	219	329	1,657	3,711	7,570	115,632	89,845	205,477	604	
25. Perth	8,772	59	1,857	732	1,347	14,569	1,319	1,729	15,476	33,777	71,810	408,597	244,417	655,014	8,452	
26. Renfrew	2,047	44	487	172	521	11,862	2,894	1,704	2,454	18,167	26,574	24,894	97,557	247,481	2,502	
27. Rose and Cromarty	5,013	27	1,123	546	583	7,312	14,755	1,991	5,259	10,224	21,062	175,793	98,251	274,042	3,080	
28. Ross and Cromarty	3,839	14	73	15	121	4,038	1,397	111	5,584	1,835	23,704	237,904	238,507	526,411	3,295	
29. Shetland	449	1	73	13	658	1,036	103	111	646	1,335	3,781	103,201	76,419	179,620	455	
30. Shetland	2,417	127	588	307	1,607	5,296	826	531	1,992	5,844	14,295	106,599	57,682	164,281	726	
31. Shetland	3,823	46	808	345	653	8,432	1,637	1,436	7,083	13,599	32,296	76,138	53,263	129,401	2,421	
32. Shetland	1,752	11	336	129	237	2,455	1,747	354	1,311	4,766	11,413	137,918	71,183	209,101	722	
33. Wigtown	3,384	73	1,125	447	723	5,701	24,610	851	8,716	20,194	56,345	89,507	49,690	119,127	16,665	
Total	128,953	1,127	31,295	13,298	21,036	198,704	361,077	43,337	44,779	229,602	545,138	1,223,933	4,224,398	2,851,400	7,972,798	159,057

* Including Mares kept for breeding.

TABLE NO. 7.—QUANTITY AND VALUE OF CORN, &c., imported into the United Kingdom in the undermentioned Years.

[From Trade and Navigation Returns.]

	Quantities.			Values.		
	1913.	1914.	1915.	1913.	1914.	1915.
Wheat from—	Cwt.	Cwt.	Cwt.	£	£	£
Russia	5,011,100	7,234,827	796,300	1,984,664	2,825,714	464,149
Germany	447,600	977,500	..	162,038	365,827	..
Turkey	41,000	89,360	26,000	11,261	10,295	18,755
Roumania	38,600	343,500	..	14,062	134,763	..
United States	34,007,944	34,220,166	41,649,000	13,953,072	14,876,510	26,533,103
Chile	765,100	50,700	..	326,244	21,033	..
Argentine Republic	14,750,200	6,407,760	12,162,900	6,137,518	2,581,389	8,613,729
British East Indies	18,766,100	10,708,900	13,959,900	7,998,552	4,922,803	8,844,968
Australia	10,128,658	12,113,400	184,400	4,426,629	5,159,157	97,383
New Zealand	56,200	8,500	..	23,210	8,726	..
Canada	21,787,900	31,457,090	19,724,800	8,863,949	13,717,995	12,625,064
Other countries	13,700	275,100	178,500	6,774	115,387	116,020
Total	105,878,102	103,926,743	88,681,800	43,849,173	44,734,079	57,313,171
Wheat, meal, and flour, from—						
Germany	455,800	215,707	..	241,825	107,547	..
Belgium	32,100	37,240	..	17,144	15,317	..
France	301,700	363,600	72,600	137,803	152,842	37,771
Austria-Hungary	99,691	56,255	..	74,217	44,389	..
United States	6,157,644	5,557,908	6,740,410	3,247,423	3,146,789	5,307,153
Argentine Republic	191,300	57,800	39,000	78,173	20,613	52,990
Australia	349,075	248,900	1,800	183,218	130,974	1,300
Canada	4,163,563	3,227,033	3,361,260	2,261,783	1,789,383	2,735,137
Other countries	222,280	295,780	224,100	101,185	141,244	180,382
Total	11,978,153	10,060,223	10,489,170	6,317,771	5,549,048	8,314,733
Barley	22,439,548	16,044,422	12,290,485	8,077,100	5,660,312	6,027,857
Oats	18,162,663	14,156,715	15,640,100	5,671,957	4,674,417	8,488,589
Peas	1,978,315	933,694	1,100,453	1,008,735	546,470	872,907
Beans	1,540,405	1,441,559	1,142,810	568,189	502,928	534,129
Indian corn or maize	49,154,953	39,040,747	48,566,400	13,769,793	11,760,912	18,897,373
Indian corn meal	491,827	232,469	247,396	182,413	78,895	112,571
Oatmeal	868,877	609,992	890,481	607,761	502,938	678,686
Offals of corn and grain, including rice-meal	4,579,852	4,890,983	8,248,301	1,091,381	1,081,163	2,464,106
Rice, exclusive of rice-meal—						
From Brit. East Indies	2,532,789	3,178,663	5,818,565	1,283,292	1,544,369	3,142,624
From other countries	1,910,135	2,238,956	4,173,314	1,071,223	1,081,306	2,199,372
Other kinds of grain and corn	1,512,467	1,613,175	1,043,485	630,444	769,109	1,447,346
Other kinds of meal and flour	272,711	195,636	160,768	131,188	96,919	76,444
Total of corn, &c. . . . .	..	..	..	84,288,370	78,582,865	110,769,868

TABLE NO. 8.—RETURN OF THE AVERAGE PRICES OF WOOL in the Years 1914 and 1915.

Years.	Australian.	South African.	English Fleeces.
	Per lb.	Per lb.	Per lb.
	s. d.	s. d.	s. d.
1914	0 11½	0 9½	0 12½ to 0 16½
1915	0 11½	0 9½	0 17½ to 0 21½

TABLE NO. 9.—QUANTITIES AND VALUES OF CORN, MEAT, FOOD PRODUCTS, AND ARTICLES AFFECTING AGRICULTURE, imported into the United Kingdom in the Year 1915, with the Corresponding Figures for 1913 and 1914.

[From Trade and Navigation Returns.]

	Quantities.			Values.		
	1913.	1914.	1915.	1913.	1914.	1915.
ANIMALS, LIVING:—	No.	No.	No.	£	£	£
Cattle	14,743	2,234	..	804,812	46,298	..
Sheep and lambs	501	1,707	..	751	3,000	..
Swine . . . . .	..	..	..	..	..	..
Total value	..	..	..	305,068	49,295	..
GRAIN, FLOUR, &C. :—	Cwt.	Cwt.	Cwt.	£	£	£
Wheat	105,878,102	103,926,743	88,651,800	43,640,173	44,734,079	57,313,171
Wheat meal and flour . .	11,978,153	10,060,223	10,489,170	6,347,771	5,549,048	8,314,738
Barley	22,439,248	16,144,422	12,290,485	8,077,100	5,060,312	6,027,857
Oats	18,162,663	14,156,715	15,040,100	5,671,957	4,074,417	8,488,589
Peas	1,973,315	983,694	1,100,453	1,000,735	540,470	872,907
Beans	1,540,405	1,441,559	1,112,810	568,189	502,938	534,139
Maize or Indian corn . .	49,154,953	39,040,747	48,566,400	13,769,793	11,760,912	18,897,378
Maize-meal	491,527	232,469	247,396	182,413	78,895	112,571
Oatmeal	868,877	600,992	690,481	607,761	502,038	878,666
Offals of corn and grain, } including rice-meal	4,579,852	4,890,983	8,248,301	1,091,381	1,081,163	2,464,106
Rice, exclusive of rice- meal—						
From British East Indies	2,532,789	3,178,663	5,818,565	1,283,292	1,544,369	3,142,024
From other countries . .	1,910,135	2,238,956	4,173,314	1,071,223	1,081,306	2,199,372
Other kinds of grain & corn	1,512,467	1,613,175	1,043,485	630,444	769,100	1,417,346
Other kinds of meal and } flour	272,711	195,636	100,768	131,138	96,019	76,444
Total value	..	..	..	84,288,370	78,582,865	110,769,868
MEAT:—	Cwt.	Cwt.	Cwt.	£	£	£
Beef, salted	49,834	29,541	68,258	111,070	65,262	181,176
*Beef	9,203,310	8,844,567	8,610,511	16,070,833	19,060,371	25,370,520
*Mutton	5,830,290	5,199,731	4,730,705	10,907,092	11,410,310	18,986,148
Bacon	4,857,890	5,093,080	6,523,377	17,428,581	18,225,568	25,441,460
Hams	874,995	838,830	1,485,191	3,063,261	3,063,078	5,296,680
Pork, salted (not bacon or } hams)	240,597	261,141	106,974	207,135	302,477	215,161
*Pork	494,264	861,203	269,305	1,368,360	2,560,722	796,409
*Meat, unenumerated . .	728,329	813,757	764,234	1,429,997	1,603,934	1,796,161
" " salted	104,138	139,534	102,833	138,409	180,329	168,946
Meat, preserved, otherwise } than by salting	880,005	995,211	2,087,651	3,707,054	5,112,291	11,652,462
*Rabbits (dead)	525,578	505,925	603,659	781,376	747,643	914,367
Total of dead meat	23,278,230	23,587,820	25,312,698	55,809,358	62,222,085	86,263,499
DAIRY PRODUCE:—	Cwt.	Cwt.	Cwt.	£	£	£
Butter	4,139,028	3,964,204	3,855,395	24,083,658	24,014,276	27,085,708
Margarine	1,518,297	1,529,219	2,052,183	3,917,701	3,977,861	5,751,258
Cheese	2,297,840	2,433,864	2,726,942	7,036,039	7,906,162	11,113,866
Total	7,954,665	7,947,287	8,634,520	35,036,398	35,957,799	43,950,835

* Fresh, Chilled, and Frozen.

TABLE No. 9—Continued.

	Quantities.			Values.		
	1913.	1914.	1915.	1913.	1914.	1915.
POULTRY (alive or dead). . .	..	..	..	£ 992,463	£ 798,961	£ 655,398
GAME (alive or dead) . . .	..	..	..	119,527	144,765	82,453
Eggs	Gt. Hunds. 21,579,950	Gt. Hunds. 17,904,805	Gt. Hunds. 10,247,960	9,590,602	8,652,800	6,122,970
Total value . . . . .	..	..	..	10,702,592	9,590,526	6,810,816
FRUIT, VEGETABLES, &c.:—	Cwt.	Cwt.	Cwt.	£	£	£
Apples	3,257,419	2,929,649	3,343,629	2,230,370	2,046,824	2,322,249
Cherries	62,267	167,966	27,302	123,230	239,468	49,656
Plums	409,877	297,680	137,776	437,306	289,096	192,698
Pears	718,928	409,871	210,537	650,084	364,894	259,045
Grapes	582,537	650,515	577,700	740,543	722,900	741,622
Oranges	5,792,631	5,168,049	6,004,360	2,476,865	2,823,235	2,635,344
Lemons	686,650	830,352	778,863	477,222	494,491	472,645
Unenumerated	355,195	248,295	184,745	325,101	253,466	219,489
Onions	Bushels. 9,165,164	Bushels. 7,513,513	Bushels. 7,472,440	1,035,053	1,480,778	1,789,080
Potatoes	Cwt. 9,427,316	Cwt. 3,332,164	Cwt. 2,110,187	2,569,038	1,535,515	1,169,617
Vegetables, unenumerated } (raw)	..	..	..	519,340	475,714	318,882
Hops	262,184	97,306	200,337	1,753,003	558,741	798,512
Total value . . . . .	..	..	..	13,567,155	10,785,112	10,968,839
OTHER ARTICLES:—	Cwt.	Cwt.	Cwt.	£	£	£
Lard	2,005,360	1,765,107	2,210,436	5,552,462	4,750,943	5,783,260
Wool, sheep and lambs' . . .	Lb. 800,580,815	Lb. 711,618,116	Lb. 926,680,080	34,226,103	31,212,739	42,027,351
Wood and timber—	Loads.	Loads.	Loads.			
Hewn (pit-props or pit-wood) }	3,451,328	2,476,864	2,168,391	4,445,066	3,269,346	4,766,501
Sawn or split, planed or dressed }	6,636,607	4,625,249	4,616,376	21,634,635	14,952,651	21,947,253
Staves	182,123	93,439	110,763	1,000,048	556,066	717,368
Oilseed-cake (not sweetened)	Tons. 405,700	Tons. 329,431	Tons. 425,113	2,539,892	1,988,839	3,273,139
Seeds—	Cwt.	Cwt.	Cwt.			
Clover and grass	269,751	175,905	260,375	623,700	410,737	707,293
Cotton	Tons. 615,332	Tons. 639,572	Tons. 491,565	4,648,617	4,420,307	4,122,193
Flax or linseed	Qrs. 3,274,062	Qrs. 2,451,778	Qrs. 2,126,409	7,195,899	5,723,846	5,578,622
Rape	265,560	309,241	192,336	531,725	622,927	461,200
Soya beans	Tons. 76,462	Tons. 71,161	Tons. 175,126	635,747	593,190	1,461,525
Bones (whether burnt or not)	40,685	34,404	27,761	219,637	186,001	179,815
Guano	25,548	39,285	26,720	149,169	232,086	182,015
Basic slag	51,133	16,672	..	102,114	31,819	..
Nitrate of soda (cubic nitre)	140,926	171,910	132,158	1,490,669	1,721,138	1,505,065
Phosphate of lime and rock } phosphate	539,016	562,242	374,639	874,166	970,337	704,749
Cotton, raw of 100 lb.	Centals. 21,742,996	Centals. 18,641,333	Centals. 26,476,542	70,570,547	55,350,626	64,672,649
Hemp	Tons. 146,278	Tons. 127,085	Tons. 145,647	4,350,229	3,486,684	4,314,432
Flax	102,453	87,126	84,806	4,771,219	4,148,126	5,962,337
Hides untanned—	Cwt.	Cwt.	Cwt.			
Dry	622,669	639,208	734,395	2,638,467	2,976,456	3,508,960
Wet	831,323	753,287	1,077,089	3,159,332	2,935,281	4,976,671
Petroleum	Gallons. 488,106,963	Gallons. 646,712,631	Gallons. 595,153,694	10,556,806	12,756,207	13,378,481

TABLE No. 10.—QUANTITY AND VALUE OF DEAD MEAT imported into the United Kingdom in the undermentioned Years.

	Quantities.			Values.		
	1913.	1914.	1915.	1913.	1914.	1915.
BACON, from—	Cwt.	Cwt.	Cwt.	£	£	£
Denmark	2,334,945	2,714,807	2,063,221	8,865,670	9,936,454	9,128,847
United States	1,803,371	1,622,958	3,529,699	6,122,320	5,337,458	12,752,834
Canada	243,522	342,286	804,185	863,139	1,224,462	3,824,611
Other countries	476,052	518,029	66,372	1,577,752	1,707,194	235,268
Total	4,857,890	5,098,030	6,523,377	17,428,881	18,225,568	25,441,460
BEEF (salted), from—						
United States	46,528	29,397	64,073	102,269	64,241	168,068
Other countries	3,306	444	4,220	8,801	1,021	13,118
Total	49,834	29,841	68,293	111,070	65,262	181,176
*BEEF (fresh and refrigerated)—						
United States	1,462	87,589	1,001,351	3,119	246,909	3,227,869
Uruguay	459,360	729,779	863,413	706,816	1,469,766	1,042,043
Argentine Republic	7,171,875	5,903,126	5,096,461	12,815,102	14,074,530	15,804,661
Australia	1,317,464	1,561,601	1,245,762	2,138,951	8,247,323	3,596,434
New Zealand	214,168	470,690	735,226	393,429	941,459	2,176,621
Denmark	304	1,313	354	91	4,487	1,075
Other countries	8,677	5,010	167,714	17,004	12,807	521,871
Total	9,203,511	8,844,567	8,610,511	16,070,833	19,960,371	25,870,520
HAMS, from—						
United States	760,567	774,805	1,364,604	2,716,004	2,827,350	4,859,895
Canada	90,082	58,945	120,719	336,695	217,814	434,485
Other countries	4,346	5,010	468	15,552	17,914	2,300
Total	854,995	838,830	1,485,191	3,068,251	3,063,078	5,296,689
*MEAT (unenumerated, fresh and refrigerated), from—						
Netherlands	208,971	276,791	150,023	509,865	656,525	856,053
United States	84,111	66,978	164,306	201,157	182,766	420,026
Argentine Republic	314,737	298,437	246,456	455,561	511,169	522,832
Other countries	224,658	311,035	3,0282	401,823	523,853	661,196
Total	832,467	954,291	877,687	1,568,406	1,874,313	1,960,107
MEAT, preserved otherwise than by salting—						
Beef	647,938	803,402	1,769,962	2,692,443	4,239,570	10,315,653
Mutton	86,224	61,274	60,245	204,034	183,370	244,200
Other sorts	154,844	130,535	207,414	810,677	689,351	1,092,609
Total	889,005	995,211	2,037,621	3,707,054	5,112,291	11,652,462
*MUTTON (fresh and refrigerated)—						
Netherlands	128,048	148,045	48,338	812,251	387,335	128,413
Uruguay	164,953	31,160	39,107	288,793	64,750	99,498
Argentine Republic	1,012,347	1,145,599	781,735	1,908,255	2,390,310	2,093,023
Australia	1,665,359	1,326,055	1,277,339	3,128,439	2,800,707	3,454,722
New Zealand	2,200,525	2,377,334	2,422,806	4,966,310	5,435,128	7,669,945
Other countries	163,528	167,554	160,880	304,914	631,580	482,647
Total	5,330,290	5,199,731	4,730,705	10,907,992	11,410,310	13,936,148
PORK (salted, not Bacon or Hams), from—						
Denmark	187,527	211,941	37,340	179,926	185,986	36,066
United States	42,266	36,795	66,244	100,354	92,472	169,637
Other countries	10,804	12,405	3,390	16,355	24,019	9,468
Total	240,597	261,141	106,974	297,135	302,477	215,161
*PORK (fresh and refrigerated)—						
Netherlands	460,022	817,736	137,692	1,268,674	2,232,664	359,812
Belgium	8,646	11,425	..	24,806	32,651	..
United States	12,019	4,511	86,628	34,192	13,157	288,534
Other countries	13,577	27,531	44,985	40,688	82,250	147,578
Total	494,264	861,203	269,305	1,368,360	2,360,722	795,409
*RABBITS (dead), from—						
Belgium	81,073	15,838	..	87,086	48,881	..
Australia	415,078	391,371	506,790	570,950	539,064	754,524
New Zealand	62,883	84,877	83,138	85,000	124,882	133,902
Other countries	12,746	13,839	8,731	35,340	30,816	25,941
Total	525,578	505,925	603,659	781,376	747,048	914,367
Total of dead meat	23,278,230	23,587,820	25,312,698	55,509,358	62,222,035	86,263,499

* In the Official Returns from 1906 the imports are shown separately as "Fresh," "Chilled," and "Frozen."

TABLE No. 11.—QUANTITIES AND VALUES OF BUTTER, MARGARINE, CHEESE, AND Eggs imported into the United Kingdom in each Year from 1913 to 1915 inclusive.

[From Trade and Navigation Returns.]

	Quantities			Values.		
	1913.	1914.	1915.	1913.	1914.	1915.
BUTTER from—	Cwt.	Cwt.	Cwt.	£	£	£
Russia . . .	751,411	616,380	1,017,507	3,831,366	3,332,411	6,371,012
Sweden . . .	332,331	270,138	129,505	2,047,634	1,647,575	980,437
Denmark . . .	1,706,759	1,749,072	1,327,100	10,657,589	11,038,637	10,221,398
Netherlands . .	153,172	183,999	44,622	921,738	1,144,181	314,254
France . . .	248,579	273,819	352,090	1,505,442	1,674,155	2,275,676
United States . .	164	7,844	77,130	947	39,372	529,200
Argentine Republic . .	72,418	55,704	82,917	394,529	325,450	569,052
Victoria . . .	275,519	204,716	106,024	1,506,399	1,174,663	748,481
New S. Wales . .	155,936	122,523	153,222	838,366	701,283	1,078,074
Queensland . .	158,914	106,694	107,421	833,105	574,883	724,473
New Zealand . .	251,663	357,920	374,898	1,351,255	2,100,958	2,693,808
Canada . . .	813	3,128	21,401	4,522	18,496	167,442
Other countries . .	33,316	32,262	53,525	190,736	192,212	362,393
Total . . .	4,139,028	3,931,231	3,555,395	24,083,658	21,014,276	27,035,703
MARGARINE from—	Cwt.	Cwt.	Cwt.	£	£	£
Netherlands . .	1,483,417	1,502,576	2,024,100	3,810,169	3,896,375	5,666,146
France . . .	19,299	13,349	17,537	71,205	50,037	60,623
Other countries . .	15,591	13,254	10,177	55,997	30,949	24,484
Total . . .	1,518,297	1,529,219	2,062,183	3,917,701	3,977,361	5,751,253
CHEESE from—	Cwt.	Cwt.	Cwt.	£	£	£
Netherlands . .	291,895	319,124	129,105	760,089	921,311	493,235
Italy . . .	101,794	97,932	75,917	343,838	328,538	297,612
United States . .	22,449	31,390	459,793	67,217	104,925	1,892,816
Australia . . .	7,933	18,157	20,948	24,568	57,584	93,498
New Zealand . .	547,182	742,419	709,326	1,685,472	2,432,117	3,081,665
Canada . . .	1,293,768	1,167,778	1,315,177	4,038,627	4,025,950	5,211,769
Other countries . .	32,319	27,061	16,676	115,228	95,737	68,454
Total . . .	2,297,340	2,433,861	2,726,942	7,035,039	7,966,162	11,113,869
EGGS from—	Great Hundreds.	Great Hundreds.	Great Hundreds.	£	£	£
Russia . . .	11,453,277	6,870,827	3,074,156	4,745,229	2,914,085	1,748,822
Denmark . . .	4,264,943	4,315,900	2,657,835	2,296,843	2,546,979	1,863,527
Germany . . .	513,740	405,894	215,816	215,816	176,289	—
Netherlands . .	977,350	1,192,286	874,013	490,717	603,323	635,856
France . . .	702,281	632,741	1,970	326,102	328,821	658
Italy . . .	845,789	874,193	4,768	420,914	431,830	3,455
Austria . . .	—	—	—	—	—	—
Hungary . . .	883,651	911,674	—	375,943	376,537	—
Other countries . .	1,938,919	2,701,290	3,635,218	719,038	1,274,936	1,870,652
Total . . .	21,579,950	17,904,805	10,247,960	9,580,602	8,652,800	6,122,970

TABLE NO. 12.—NUMBER OF LIVE STOCK IN 1912, 1913, AND 1914, returned as entering the Markets at the Places scheduled under the Markets and Fairs (Weighing of Cattle) Act, 1891.

[From Agricultural Statistics, 1914.]

	CATTLE.			SHEEP.			SWINE.		
	1912.	1913.	1914.	1912.	1913.	1914.	1912.	1913.	1914.
Aberdeen .	67,165	73,576	74,721	226,718	196,501	208,063	13,724	12,071	13,200
Dundee .	14,427	18,129	16,033	29,451	30,726	27,246	4,371	3,664	3,813
Edinburgh	57,509	70,742	63,742	226,927	230,135	217,528	7,647	6,848	7,006
Stirling .	62,789	73,144	59,364	265,135	230,064	246,610	5,068	3,789	4,260
Glasgow .	49,213	77,472	66,957	362,153	376,147	369,648	6,974	4,559	4,887
Perth . .	86,648	126,600	98,045	499,350	441,928	403,741	14,940	12,039	11,635
	337,751	439,663	378,862	1,609,734	1,506,401	1,472,826	52,724	42,970	44,801

TABLE NO. 13.—AVERAGE PRICES OF FAT CATTLE PER CWT. (LIVE WEIGHT) at the undermentioned Places in each Year from 1907 to 1914, together with the average Prices for Scotland, England, and Great Britain, compiled from the Returns received under the Markets and Fairs (Weighing of Cattle) Act, 1891.

	1907.	1908.	1909.	1910.	1911.	1912.	1913.	1914.
	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>
Aberdeen . . .	32 8	33 6	34 5	35 10	34 7	38 9	38 4	39 0
Dundee . . .	32 8	33 5	34 0	35 8	34 0	38 1	37 0	37 9
Edinburgh . . .	35 1	36 5	37 2	38 7	36 10	41 2	39 10	40 7
Glasgow . . .	33 1	34 3	34 10	36 2	35 1	39 7	38 9	39 10
Perth . . .	35 8	37 0	37 11	40 3	37 10	42 2	40 7	41 3
SCOTLAND . . .	33 9	34 8	35 6	37 2	35 8	40 0	38 11	39 8
ENGLAND . . .	33 6	34 2	34 8	36 0	35 0	37 9	38 11	39 8
GREAT BRITAIN .	33 8	34 7	35 4	36 11	35 6	39 6	38 11	39 8

TABLE NO. 14.—NUMBER AND VALUE OF LIVE CATTLE, SHEEP, AND SWINE imported into the United Kingdom in the undermentioned Years. [*From Trade and Navigation Returns.*]

	Number.			Value.		
	1913.	1914.	1915.	1913.	1914.	1915.
CATTLE, from—				£	£	£
Channel Islands . . .	2,895	2,174	..	55,075	42,027	..
Canada	1,755	..	..	36,212	..	..
United States . . .	10,093	..	..	213,025	..	..
Argentine Republic .	..	..	..	..	..	..
Other countries . . .	..	60	..	..	4,268	..
Total	14,743	2,234	..	304,312	46,295	..
SHEEP AND LAMBS, from—						
Canada	501	..	..	751	..	..
United States . . .	..	1,707	..	..	3,000	..
Argentine Republic .	..	..	..	..	..	..
Other countries . . .	..	..	..	..	..	..
Total	501	1,707	..	751	3,000	..
SWINE (not separately enumerated) }	..	..	..	..	..	..
TOTAL VALUE OF ANIMALS LIVING }	..	..	..	305,063	49,295	..

TABLE NO. 15.—NUMBER OF HORSES, CATTLE, SHEEP, AND PIGS imported into Great Britain from Ireland in each of the Years 1909-1915.

	1909.	1910.	1911.	1912.	1913.	1914.	1915.
HORSES :—							
Stallions	234	277	228	287	265	188	276
Mares	13,728	15,580	15,283	17,010	17,014	15,227	7,729
Geldings	15,273	15,945	16,067	17,414	18,312	15,338	9,806
Total	29,235	31,802	31,578	34,711	36,491	30,753	17,811
CATTLE: Oxen, Bulls, and Cows :—							
Fat	265,952	259,415	269,527	336,559	354,734	455,444	363,272
Store	505,312	543,891	390,041	193,922	692,228	448,703	440,995
Other cattle	13,377	12,324	8,789	8,851	8,152	6,096	9,459
Calves	52,785	52,800	26,471	15,767	53,045	84,335	27,009
Total	837,426	867,930	694,828	555,099	1,108,159	944,578	840,735
SHEEP :—							
Sheep	430,839	347,784	306,124	328,028	319,284	256,607	229,896
Lambs	440,019	381,557	348,078	290,681	336,416	280,932	259,495
Total	870,858	729,341	654,197	618,659	655,700	537,539	489,391
PIGS :—							
Fat	316,891	301,576	323,574	253,165	187,422	146,458	171,963
Store	10,287	22,479	18,766	12,076	12,874	1,464	7,098
Total	327,128	324,055	342,340	265,241	200,296	147,922	179,066

EDINBURGH CORN-MARKET GRAIN TABLES for WHEAT, BARLEY, OATS, and BEANS, showing the Quantity offered for Sale, the Quantity Sold, the Highest, Lowest, and Average Prices; also the Bushel-weights of the Highest and Lowest Prices of each kind of Grain for every Market-day, likewise the Results for every Month, and the final Result for the year 1915.

WHEAT.

Date.	Quantity offered for Sale.	Quantity Sold.	Highest Price.	Lowest Price.	Average Price.	Table of Bushel-weights for			
						Highest Price.		Lowest Price.	
1915						1b.	1b.	1b.	1b.
Jan.	Imp. qr.	Imp. qr.	s. d.	s. d.	s. d.	68		62	68
6	494	494	51 6	49 0	49 10	68		62	68
13	643	443	52 6	50 0	52 0	68		63	68
20	1,153	958	53 6	52 6	53 0	68		63	68
27	1,176	1,066	54 6	53 0	53 11	68		63	68
	3,466	2,961	53 6	51 2	52 8				
Feb.									
8	907	636	58 0	54 0	56 9	68		63	68
10	940	815	59 0	57 0	58 1	63		63	68
17	397	317	60 0	54 0	58 6	63		58½	68
24	1,073	983	59 0	57 0	57 9	63		63	68
	3,317	2,751	58 11	56 7	57 8				
March									
8	959	514	57 0	48 0	55 6	68		61	68
10	1,336	1,071	56 0	53 9	54 10	63		63	68
17	428	258	56 8	54 0	55 8	63		63	68
24	770	605	56 0	53 6	55 1	63		63	68
31	430	310	56 6	51 0	55 5	63		62	68
	3,923	2,758	56 4	53 2	55 1				
April									
7	412	247	56 0	54 0	54 10	62	63	63	68
14	198	198	56 6	54 6	55 9	63		63	68
21	295	295	58 6	56 0	57 10	63		62	68
28	284	229	60 6	59 0	59 11	63		63	68
	1,189	969	57 9	55 5	57 1				
May									
5	882	622	62 0	59 6	61 0	63		63	68
12	563	548	63 0	61 0	62 4	63		63	68
19	801	586	63 6	58 0	62 5	63		63	68
26	1,209	712	62 6	61 6	62 4	63		63	68
	3,545	2,468	62 6	60 8	62 0				
June									
2	929	575	60 6	59 0	59 11	63		63	68
9	1,596	1,588	55 0	53 6	54 6	68		63	68
16	451	418	52 0	48 0	49 5	63		63	68
23	237	116	47 0	42 6	46 5	63		63	68
30	139	139	50 0	49 0	49 6	63		63	68
	3,352	2,836	54 4	51 11	54 8				
July									
7	108	103	52 6	..	52 6	63		..	68
14	233	233	55 0	52 0	54 8	63		61	68
21	291	296	56 0	53 0	54 11	68		63	68
28	195	72	56 6	56 0	56 8	63		63	68
	827	704	54 8	53 6	54 6				

WHEAT—continued.

Date.	Quantity offered for Sale.	Quantity Sold.	Highest Price.	Lowest Price.	Average Price.	Table of Bushel-weights for			
						Highest Price.		Lowest Price.	
1915	Imp. qr.	Imp. qr.	s. d.	s. d.	s. d.	lb.	lb.	lb.	lb.
Aug. 4	650	500	57 0	52 6	56 3	63		63	
11	274	140	57 0	56 0	56 3	63		63	
18	490	180	56 0	54 0	55 4	63		63	
25	198	148	55 0	54 6	54 10	63		63	
	1,612	1,058	55 10	55 0	55 11				
Sept. 1	96	96	52 0	..	52 0	63		..	
8	40	40	51 0	..	51 0	63		..	
15	330	169	46 3	38 0	44 3	62		60	
22	155	155	46 0	34 8	43 1	63		58½	
29	190	90	44 6	43 0	43 11	61		62	
	811	541	48 9	39 1	45 8				
Oct. 6	552	570	50 0	41 3	45 2	63		60½	
13	202	192	48 9	40 0	46 2	62		5½	
20	273	192	56 0	47 0	50 6	63		62	
27	421	370	56 0	49 8	52 9	63		61	
	1,448	1,124	52 10	44 0	48 9				
Nov. 3	382	212	62 6	45 6	53 5	63		60½	
10	735	650	62 6	49 6	54 0	63		62	
17	497	403	60 0	48 9	54 9	63		60½	
24	778	605	56 0	54 6	55 2	63		63	
	2,892	1,870	56 9	52 1	54 6				
Dec. 1	775	775	55 6	53 0	54 5	63		61	
8	320	320	57 0	54 0	55 6	63		63	
15	277	212	56 6	53 0	54 11	63		62½	
22	586	418	57 0	51 0	55 11	63		61	
29	614	334	57 6	55 0	56 8	63		59½	61
	2,572	2,059	56 10	53 6	55 4				
Result for year	28,454	22,099	55 10	53 1	55 8				

BARLEY.

1915							
Jan. 6	1,053	723	34 6	33 6	34 4	56	56
13	754	646	36 6	34 0	35 2	56	55 56
20	816	816	37 0	34 6	36 1	56	55 56
27	900	267	38 0	34 0	37 5	56	56
	3,523	2,452	35 6	33 11	35 6		
Feb. 8	681	240	37 9	35 6	37 2	56	54
10	1,067	503	39 0	36 0	37 9	56	55½ 56
17	983	678	41 6	35 0	37 0	58	56
24	941	171	41 6	35 9	37 0	58	56½
	3,622	1,612	39 1	35 7	37 8		

BARLEY—continued.

Date.	Quantity offered for Sale.	Quantity Sold.	Highest Price.	Lowest Price.	Average Price.	Table of Bushel-weights for	
						Highest Price.	Lowest Price.
1915							
March	Imp. qr.	Imp. qr.	s. d.	s. d.	s. d.	lb. lb.	lb. lb.
8	1,161	204	37 0	35 6	36 8	56	56
10	1,042	473	35 6	32 0	33 11	56	56
17	518	274	36 0	31 0	32 5	56	56
24	469	454	35 0	32 0	33 10	56	56
31	397	227	38 0	30 0	32 5	56	56
	3,582	1,632	35 0	32 1	33 9		
April							
7	136	136	33 6	32 0	33 2	56	55
14	155	105	33 0	31 9	32 5	55	56
21	156	30	34 6	..	34 6	56	56
28	157	..	..	..	..	..	..
	604	271	33 6	31 10	33 0		
May							
5	518	..	..	..	..	..	..
12	519	435	38 3	37 0	38 2	56	56
19	405	75	38 6	37 6	38 0	56	56
26	601	533	39 6	38 0	38 6	56	56
	2,043	1,043	38 5	37 10	38 4		
June							
2	178	100	38 0	..	38 0	56	..
9	357	227	38 0	37 0	37 11	56	56
16	447	48	37 0	..	37 0	56	..
23	94	94	36 0	..	36 0	56	..
30	105	45	36 0	..	36 0	56	..
	1,271	514	37 4	37 0	37 4		
July							
7	..	..	..	..	..	..	..
14	..	..	..	..	..	..	..
21	..	..	..	..	..	..	..
28	..	..	..	..	..	..	..
		
Aug.							
4	62	12	40 0	..	40 0	56	..
11	..	..	..	..	..	..	..
18	..	..	..	..	..	..	..
25	..	..	..	..	..	..	..
	62	12	40 0	..	40 0		
Sept.							
1	30	30	42 6	..	42 6	56	..
8	392	292	42 0	38 6	40 7	56	56
15	727	690	44 0	40 0	41 6	56	55
22	393	303	44 0	42 0	43 5	56	56
29	751	751	45 0	40 0	43 11	55	56
	2,293	2,165	44 2	40 0	42 7		
Oct.							
6	1,167	1,150	47 6	42 0	45 1	56	54
13	647	647	49 0	43 6	46 10	56	54
20	482	482	52 0	46 0	49 2	56	56
27	881	678	52 0	49 0	50 10	56	55
	3,177	2,957	50 3	45 0	47 6		

BARLEY—continued.

Date.	Quantity offered for Sale.	Quantity Sold.	Highest Price.	Lowest Price.	Average Price.	Table of Bushel-weights for			
						Highest Price.		Lowest Price.	
1915	Imp. qr.	Imp. qr.	s. d.	s. d.	s. d.	1b.	1b.	1b.	1b.
Nov.									
8	1,068	844	52 0	48 0	50 3	56		56	
10	601	601	52 8	48 6	51 5	56		56	
17	450	450	54 0	49 0	52 4	56		56	
24	446	423	55 6	52 6	54 2	56		56	
	2,565	2,818	53 0	49 5	51 10				
Dec.									
1	552	412	55 0	53 0	54 0	56		56	
8	102	117	55 0	54 6	54 11	56		56	
15	254	166	55 0	53 0	54 8	56		55	
22	240	240	56 0	55 6	54 11	56		56	
29	193	186	56 6	55 0	56 0	56		56	
	1,381	1,071	55 5	53 7	54 8				
Result for year }	24,123	16,047	41 7	39 8	42 6				

OATS.

1915							
Jan.							
6	1,229	813	31 0	27 0	29 6	44½	41
13	1,303	904	32 0	29 0	30 4	44½	42
20	1,140	423	32 6	30 0	31 2	44½	42 43½
27	1,125	672	36 0	29 6	31 1	44½	42 44½
	4,797	2,872	32 2	29 4	30 5		
Feb.							
3	1,116	608	33 9	30 6	32 3	44½	42
10	828	477	34 3	31 6	32 9	44½	42
17	1,384	1,034	35 0	31 0	32 8	44½	41 42
24	1,717	717	35 9	31 6	32 9	44½	42
	4,995	2,836	34 8	31 2	32 7		
March							
3	1,985	646	34 6	30 6	32 0	44½	42
10	1,949	851	36 6	30 0	31 6	44½	42
17	1,429	620	33 0	29 6	31 1	43 44½	42
24	1,061	753	33 0	29 9	31 3	42 45	42
31	934	155	34 0	30 6	31 3	44½	42
	7,808	2,525	33 9	30 0	31 5		
April							
7	544	230	32 0	30 6	31 4	42 44½	42
14	590	187	35 0	31 9	33 0	44½	42
21	466	346	35 6	32 3	33 6	44½	42
28	607	320	36 0	33 6	34 10	44½	42 44½
	2,207	1,083	34 10	31 10	33 4		
May							
5	735	367	38 0	34 0	35 2	47½	42
12	653	430	37 9	34 0	35 4	44½	42
19	553	84	38 0	36 0	37 3	44½	42
26	670	565	39 0	34 6	36 10	44½	42
	2,611	1,446	38 1	34 2	36 0		

OATS—continued.

Date.	Quantity offered for Sale.	Quantity Sold.	Highest Price.	Lowest Price.	Average Price.	Table of Bushel- weights for	
						Highest Price.	Lowest Price.
1915							
June	Imp. qr.	Imp. qr.	s. d.	s. d.	s. d.	lb. lb.	lb. lb.
2	681	291	38 6	35 0	36 11	44½	42
9	1,216	528	37 6	34 0	35 3	44½	42
16	1,236	385	36 0	32 0	33 4	44½	42
23	1,225	559	35 3	31 0	32 8	44½	42
30	676	413	34 6	32 0	32 8	44½	42
	5,034	2,176	36 9	32 10	34 0		
July							
7	568	178	34 3	32 6	33 3	44½	42
14	651	60	32 6	31 9	32 1	42	42
21	313	246	34 6	32 0	32 6	44	42
28	455	343	35 6	30 6	33 2	44½	42
	1,987	827	34 5	32 0	32 11		
Aug.							
4	721	435	36 0	33 0	34 9	44	42
11	510	100	33 6	33 3	33 5	42	42
18	798	388	35 6	32 0	33 11	44½	42
25	812	185	35 6	33 0	33 10	44½	42
	2,841	1,108	35 0	32 9	34 2		
Sept.							
1	1,016	658	35 0	29 0	31 4	44½	42
8	1,333	888	33 0	27 0	29 1	44½	42 43½
15	890	519	31 0	26 0	27 6	43	42
22	737	489	33 0	25 6	27 3	44½	42
29	518	275	29 6	28 0	28 5	44½	42
	4,994	2,829	31 11	27 3	28 11		
Oct.							
6	454	254	31 0	26 0	29 2	44½	41
13	403	403	32 0	29 0	30 9	42 44½	42 42½
20	646	314	32 6	29 0	31 4	42	42
27	683	483	34 6	30 9	32 1	44½	42
	2,086	1,454	32 2	29 8	31 0		
Nov.							
3	887	632	34 6	30 6	32 1	42½ 43	41
10	1,162	481	34 6	31 0	32 5	43	42 44½
17	1,013	390	34 0	31 6	32 8	44½ 45½	42
24	1,668	652	33 0	30 0	31 2	43 45½	42
	4,730	2,155	33 11	30 5	32 0		
Dec.							
1	1,025	713	33 0	29 0	30 7	44½	42
8	701	633	33 3	29 0	31 5	44½	42
15	736	503	33 9	29 6	32 1	44½	42
22	1,035	825	34 0	30 0	31 8	44½	42
29	772	434	33 6	31 0	32 6	43 44½	42
	4,269	3,108	33 6	30 0	31 7		
Result for year	47,859	24,419	34 3	30 11	31 11		

BEANS.

Date.	Quantity offered for Sale.	Quantity Sold.	Highest Price.	Lowest Price.	Average Price.	Table of Bushel- weights for			
						Highest Price.		Lowest Price.	
1915						lb.	lb.	lb.	lb.
Jan.	Imp. qr.	Imp. qr.	s. d.	s. d.	s. d.				
6	..	..	..	..	..	..	..	..	..
13	..	..	..	..	..	..	..	..	..
20	..	..	..	..	..	..	..	..	..
27	..	..	..	..	..	..	..	..	..
				
Feb.									
3	3	..	..	..	..	..	..	..	..
10	..	..	..	..	..	..	..	..	..
17	..	..	..	..	..	..	..	..	..
24	..	..	..	..	..	..	..	..	..
	3	..	..	..	..
March									
3	35	..	..	..	..	..	..	..	..
10	..	..	..	..	..	..	..	..	..
17	..	..	..	..	..	..	..	..	..
24	40	..	..	..	..	..	..	..	..
31	75	45	46 0	..	46 0	65½	..	..	..
	150	45	46 0	..	46 0				
April									
7	30	..	..	..	..	..	..	..	..
14	..	..	..	..	..	..	..	..	..
21	..	..	..	..	..	..	..	..	..
28	..	..	..	..	..	..	..	..	..
	30	..	..	..	..
May									
6	..	..	..	..	..	..	..	..	..
12	..	..	..	..	..	..	..	..	..
19	..	..	..	..	..	..	..	..	..
26	..	..	..	..	..	..	..	..	..
				
June									
2	..	..	..	..	..	..	..	..	..
9	..	..	..	..	..	..	..	..	..
16	..	..	..	..	..	..	..	..	..
23	..	..	..	..	..	..	..	..	..
30	..	..	..	..	..	..	..	..	..
				
July									
7	..	..	..	..	..	..	..	..	..
14	..	..	..	..	..	..	..	..	..
21	..	..	..	..	..	..	..	..	..
28	..	..	..	..	..	..	..	..	..
				
Aug.									
4	..	..	..	..	..	..	..	..	..
11	..	..	..	..	..	..	..	..	..
18	..	..	..	..	..	..	..	..	..
25	..	..	..	..	..	..	..	..	..
				

BEANS—continued.

Date.	Quantity offered for Sale.	Quantity Sold.	Highest Price.	Lowest Price.	Average Price.	Table of Bushel- weights for	
						Highest Price.	Lowest Price.
1915 Sept.	Imp. qr.	Imp. qr.	s. d.	s. d.	s. d.	1b. 1b.	1b. 1b.
1
8
15
22
29
		
Oct.							
6
13
20
27
		
Nov.							
8
10
17
24
		
Dec.							
1
8
15
22
29
		
Result } for year }	183	45	46 0	..	46 0		

PRICES OF SHEEP SINCE 1818.

TABLE No. 1.—CHEVIOT SHEEP.

Year.	Wethers.			Ewes.			Lambs.		
	s.	d.	d.	s.	d.	s.	s.	d.	d.
1818	28	0	to 30	0	not quoted.	8	0	to 10	0
1819	25	0	" 27	0	15	0	to 17	0	0
1820	20	0	" 25	0	16	0	" 17	0	0
1821	18	0	" 20	0	14	0	" 16	0	0
1822	12	6	" 13	0	8	0	" 8	6	0
1823	13	6	" 18	0	7	0	" 10	6	0
1824	14	0	" 19	0	7	0	" 9	0	0
1825	20	0	" 32	0	15	0	" 19	0	0
1826	17	6	" 21	6	13	0	" 15	0	0
1827	15	0	" 24	0	not quoted.	7	0	" 8	0
1828	18	0	" 27	6	12	0	to 15	0	0
1829	18	0	" 24	0	12	6	" 14	0	0
1830	15	0	" 21	0	8	0	" 11	0	0
1831	18	0	" 25	0	9	0	" 13	0	0
1832	19	0	" 24	0	11	0	" 16	0	0
1833	22	0	" 31	0	13	6	" 20	0	0
1834	22	0	" 31	0	13	6	" 21	0	0
1835	22	0	" 27	6	18	0	" 20	6	0
1836	24	0	" 31	6	16	0	" 19	0	0
1837	19	0	" 28	0	14	0	" 19	0	0
1838	23	0	" 30	6	17	0	" 22	0	0
1839	23	0	" 31	0	14	0	" 19	0	0
1840	24	0	" 33	0	15	0	" 23	0	0
1841	23	0	" 30	0	14	0	" 22	0	0
1842	22	6	" 28	0	13	0	" 17	0	0
1843	19	0	" 25	0	8	0	" 12	0	0
1844	21	0	" 29	0	10	0	" 16	0	0
1845	23	0	" 33	0	13	0	" 20	0	0
1846	24	0	" 33	6	14	6	" 21	6	0
1847	24	0	" 35	0	13	0	" 24	0	0
1848	23	0	" 34	6	13	0	" 28	0	0
1849	21	0	" 30	2	12	0	" 21	0	0
1850	20	6	" 29	6	12	0	" 20	0	0
1851	21	6	" 31	0	13	0	" 21	0	0
1852	21	0	" 32	0	15	0	" 23	0	0
1853	26	6	" 38	0	17	0	" 28	6	0
1854	25	0	" 36	0	17	0	" 26	0	0
1855	23	6	" 36	0	16	0	" 25	0	0
1856	22	0	" 35	6	15	6	" 24	0	0
1857	24	0	" 36	0	14	6	" 26	0	0
1858	24	0	" 34	6	14	0	" 24	6	0
1859	25	0	" 34	6	16	0	" 25	0	0
1860	26	0	" 38	0	17	6	" 27	6	0
1861	25	0	" 38	6	16	0	" 28	0	0
1862	27	0	" 37	6	17	6	" 28	0	0
1863	25	0	" 38	6	19	0	" 28	6	0
1864	31	0	" 41	0	21	0	" 31	6	0
1865	32	6	" 44	0	22	6	" 33	6	0
1866	37	0	" 50	0	29	0	" 42	6	0
1867	26	0	" 58	0	18	0	" 25	6	0
1868	30	0	" 32	0	15	6	" 21	0	0
1869	28	0	" 38	0	15	0	" 22	6	0
1870	35	6	" 43	0	18	0	" 28	0	0</

TABLE NO. 1.—OHEVIOT SHEEP—*Continued.*

Year.	Wethers.				Ewes.				Lambs.						
	s.	d.	to	s.	d.	s.	d.	to	s.	d.	s.	d.	to	s.	d.
1889	36	0	to	44	0	24	0	to	32	0	14	0	to	22	0
1890	31	0	"	40	0	22	0	"	30	0	12	6	"	20	0
1891	27	0	"	38	0	16	0	"	25	0	9	0	"	16	0
1892	22	0	"	30	6	13	0	"	22	0	5	0	"	11	0
1893	26	0	"	35	6	18	0	"	28	6	8	6	"	15	0
1894	26	0	"	37	0	20	0	"	31	0	10	6	"	18	6
1895	28	0	"	39	0	22	0	"	34	0	11	6	"	19	6
1896	24	6	"	34	0	19	0	"	30	6	9	0	"	16	6
1897	27	0	"	36	0	21	0	"	31	6	11	0	"	17	6
1898	27	0	"	37	0	22	0	"	32	6	12	0	"	18	6
1899	24	0	"	33	0	20	0	"	30	6	10	6	"	16	0
1900	26	0	"	36	0	22	0	"	32	6	12	0	"	17	0
1901	25	0	"	32	6	20	0	"	29	6	11	0	"	16	0
1902	24	0	"	31	6	18	0	"	27	0	9	6	"	14	6
1903	26	0	"	34	0	21	0	"	31	0	11	4	"	18	0
1904	28	6	"	36	6	23	0	"	32	6	13	0	"	20	0
1905	27	6	"	35	0	23	0	"	33	0	14	0	"	21	0
1906	30	0	"	38	0	26	0	"	34	6	15	0	"	23	0
1907	28	0	"	34	0	22	0	"	30	6	13	6	"	19	6
1908	26	0	"	32	6	21	0	"	27	6	11	6	"	17	0
1909	24	0	"	31	0	18	0	"	25	6	9	6	"	16	0
1910	27	0	"	35	0	22	0	"	31	0	12	0	"	20	0
1911	24	0	"	31	6	18	6	"	27	6	10	6	"	18	0
1912	26	0	"	34	6	22	0	"	31	0	13	0	"	21	0
1913	30	0	"	39	0	24	0	"	35	6	16	0	"	24	0
1914	32	6	"	41	0	28	0	"	39	0	18	0	"	27	6
1915	36	0	"	46	0	31	0	"	44	0	20	0	"	30	6

TABLE NO. 2.—BLACKFACE SHEEP.

Year.	Wethers.				Ewes.				Lambs.				
	s.	d.		s.	d.	s.	d.		s.	d.		s.	d.
1819	22	0	to	24	0	12	0	to	15	0		8	0
1820	20	0	"	23	3	15	6	"	17	0		7	0
1821	18	0	"	20	0	12	0	"	18	0		6	0
1822	11	6	"	13	6	5	6	"	6	0		4	6
1823	12	0	"	16	0	5	0	"	6	6		4	0
1824	9	6	"	13	6	6	0	"	7	0		4	0
1825	22	0	"	26	0	11	0	"	18	6		6	0
1826	15	0	"	17	0	8	0	"	9	0		4	6
1827	14	0	"	18	6	7	0	"	10	0		6	0
1828	15	0	"	20	0	8	0	"	11	0		5	0
1829	14	0	"	18	0	9	0	"	10	0		6	0
1830	9	6	"	13	6	4	0	"	6	0		4	6
1831	13	0	"	17	0	5	0	"	7	6		5	0
1832	14	0	"	18	0	7	0	"	11	6		6	0
1833	16	0	"	24	0	7	6	"	12	0		6	6
1834	16	0	"	22	0	10	0	"	13	0		6	0
1835	15	0	"	18	9	10	0	"	13	0		7	0
1836	15	0	"	21	0	9	0	"	12	0		8	6
1837	13	0	"	16	0	8	0	"	12	0		8	0
1838	15	0	"	20	6	10	0	"	13	0		not quoted.	
1839	15	0	"	22	0	10	0	"	12	0		7	0
1840	15	0	"	22	6	11	0	"	12	0		7	0
1841	16	0	"	20	0	9	0	"	11	0		6	0
1842	14	0	"	19	0	7	6	"	8	6		5	6
1843	not quoted.				4	9	"	6	6	not quoted.			
1844	15	0	to	21	0	6	6	"	10	0		5	0
1845	14	0	"	23	0	8	0	"	12	0		6	0
1846	13	0	"	24	0	10	0	"	13	0		8	0
1847	20	6	"	25	0	10	0	"	14	0		8	6
1848	20	0	"	24	0	11	3	"	12	0		8	6
1849	not quoted.				not quoted.				7	0	"	7	6
1850	not quoted.				not quoted.				7	0	"	0	0
1851	17	6	to	23	0	9	0	to	12	6		6	6
1852	18	6	"	22	6	9	6	"	12	0		4	6
1853	23	9	"	27	6	14	6	"	16	6		8	0
1854	20	0	"	26	0	11	0	"	16	6		8	0
1855	23	6	"	26	6	14	0	"	16	0		10	0
1856	17	0	"	24	0	16	0	"	20	0		7	6
1857	20	0	"	29	0	10	6	"	15	0		9	3
1858	20	0	"	27	6	9	9	"	13	9		8	3
1859	20	0	"	25	0	10	0	"	14	0		8	9
1860	21	0	"	27	3	11	0	"	16	0		10	0
1861	21	0	"	29	0	12	0	"	22	0		6	3
1862	16	9	"	27	0	12	0	"	13	8		6	0

TABLE NO. 2.—BLACKFACE SHEEP—Continued.

Year.	Wethers.			Ewes.			Lambs.		
	s.	d.	d.	s.	d.	d.	s.	d.	d.
1863	20	0	to 80	18	0	to 16	8	0	to 11
1864	25	0	" 80	15	0	" 19	10	0	" 18
1865	15	6	" 82	15	0	" 25	10	0	" 17
1866	81	6	" 40	20	0	" 86	13	6	" 22
1867	20	0	" 80	14	0	" 22	7	6	" 18
1868	20	0	" 26	10	6	" 13	7	0	" 18
1869	22	0	" 28	11	0	" 14	6	9	" 9
1870	27	0	" 82	18	0	" 22	8	0	" 14
1871	23	0	" 37	18	0	" 28	11	0	" 16
1872	81	6	" 46	18	0	" 82	12	6	" 18
1873	28	0	" 39	16	6	" 27	7	0	" 16
1874	25	0	" 85	18	0	" 20	7	0	" 14
1875	26	6	" 37	15	0	" 21	9	6	" 17
1876	80	0	" 40	19	0	" 24	13	0	" 20
1877	85	0	" 38	18	0	" 25	13	6	" 23
1878	80	0	" 86	17	0	" 23	12	0	" 22
1879	25	0	" 35	16	0	" 24	10	6	" 20
1880	25	0	" 38	16	6	" 22	10	0	" 17
1881	30	0	" 39	15	0	" 23	10	0	" 15
1882	83	0	" 46	20	0	" 28	12	6	" 18
1883	86	0	" 50	24	6	" 33	14	0	" 21
1884	29	0	" 48	19	6	" 28	12	0	" 19
1885	24	0	" 34	18	0	" 22	10	0	" 15
1886	25	0	" 34	12	0	" 22	10	6	" 16
1887	22	0	" 30	11	0	" 19	8	0	" 13
1888	22	0	" 32	18	0	" 24	10	0	" 15
1889	26	0	" 40	18	0	" 29	13	0	" 22
1890	24	0	" 37	14	0	" 27	10	6	" 19
1891	21	0	" 37	10	0	" 24	7	6	" 15
1892	16	0	" 28	6	0	" 17	3	0	" 10
1893	21	0	" 37	12	0	" 24	7	0	" 14
1894	20	0	" 37	14	6	" 26	8	6	" 16
1895	23	0	" 41	16	0	" 28	9	0	" 17
1896	19	0	" 35	13	0	" 24	6	0	" 13
1897	21	0	" 36	15	0	" 25	7	0	" 14
1898	22	0	" 37	16	0	" 26	8	0	" 15
1899	20	0	" 33	13	0	" 24	5	6	" 13
1900	23	0	" 36	16	0	" 26	8	0	" 15
1901	20	0	" 35	14	0	" 25	6	6	" 14
1902	18	6	" 34	12	0	" 24	6	0	" 14
1903	21	0	" 36	15	0	" 28	7	0	" 16
1904	23	0	" 38	18	0	" 30	8	6	" 17
1905	21	6	" 37	19	0	" 31	9	0	" 18
1906	23	0	" 38	20	0	" 33	10	0	" 19
1907	21	0	" 33	17	0	" 28	8	6	" 17
1908	19	6	" 30	15	0	" 24	8	0	" 16
1909	17	0	" 28	11	6	" 22	6	3	" 13
1910	21	6	" 32	16	0	" 27	8	0	" 17
1911	19	0	" 29	14	0	" 24	7	0	" 15
1912	21	6	" 32	17	0	" 27	9	6	" 17
1913	24	6	" 36	21	0	" 31	12	6	" 21
1914	27	0	" 38	25	0	" 34	15	6	" 24
1915	31	0	" 42	29	0	" 39	17	0	" 25

TABLE NO. 3.—PRICE OF WOOL, PER STONE OF 24 LB., SINCE 1818.

Year.	Laid Cheviot.		White Cheviot.		Laid Highland.		White Highland.	
	s.	d.	s.	d.	s.	d.	s.	d.
1818	40	0 to	42	2	20	0 to	22	6
1819	21	0 "	22	0	10	0 "	10	3
1820	20	0 "	22	0	9	0 "	10	0
1821	18	0 "	20	0	9	0 "	10	0
1822	12	6 "	14	6	5	0 "	6	6
1823	9	0 "	10	6	5	0 "	5	9
1824	18	6 "	15	0	6	0 "	6	3
1825	10	6 "	22	0	10	0 "	10	6
1826	11	0 "	14	0	5	0 "	5	6
1827	11	0 "	14	0	5	6 "	6	9
1828	8	0 "	11	0	5	6 "	6	0
1829	8	6 "	11	0	4	3 "	0	0
1830	9	6 "	11	0	4	6 "	5	0
1831	17	0 "	20	0	7	6 "	8	6
1832	14	0 "	16	0	7	0 "	7	6
1833	18	0 "	20	7	10	0 "	11	0
1834	21	0 "	24	6	5	6 "	7	0
1835	19	0 "	20	6	9	6 "	10	8
1836	21	0 "	25	0	10	0 "	14	0
1837	12	0 "	14	0	7	0 "	7	8

TABLE NO. 3.—PRICE OF WOOL—Continued.

Year.	Laid Cheviot.		White Cheviot.		Laid Highland.		White Highland.	
	s.	d.	s.	d.	s.	d.	s.	d.
1838	19	0	to	22	6	..	..	..
1839	18	0	"	20	0	..	..	..
1840	15	0	"	0	0	..	..	..
1841	15	0	"	16	9	..	..	..
1842	12	6	"	14	0	..	..	..
1843	9	0	"	11	6	..	..	..
1844	15	0	"	18	0	..	..	..
1845	14	6	"	17	6	..	..	..
1846	12	0	"	14	6	..	..	..
1847	12	6	"	14	0	..	..	..
1848	9	6	"	11	0	..	..	..
1849	12	0	"	16	6	..	..	..
1850	15	0	"	17	6	..	..	..
1851	12	0	"	16	0	..	..	..
1852	18	0	"	15	0	..	..	..
1853	19	0	"	22	0	..	..	..
1854	12	0	"	15	0	..	..	..
1855	14	6	"	19	0	..	..	..
1856	19	0	"	21	6	..	..	..
1857	19	0	"	24	0	..	..	..
1858	15	0	"	17	0	..	..	..
1859	18	6	"	24	0	..	..	..
1860	22	0	"	32	0	..	..	..
1861	19	6	"	27	0	..	..	..
1862	18	6	"	26	0	..	..	..
1863	25	6	"	31	0	..	..	..
1864	31	0	"	39	0	..	..	..
1865	23	0	"	30	0	..	..	..
1866	24	0	"	30	0	..	..	..
1867	16	0	"	21	6	..	..	..
1868	19	0	"	26	0	..	..	..
1869	18	0	"	26	6	..	..	..
1870	15	0	"	23	6	..	..	..
1871	20	0	"	26	6	..	..	..
1872	26	0	"	37	6	..	..	..
1873	17	0	"	18	0	..	..	..
1874	18	6	"	26	6	..	..	..
1875	25	0	"	32	0	..	..	..
1876	20	0	"	24	0	..	..	..
1877	20	9	"	26	0	..	..	..
1878	18	9	"	25	0	..	..	..
1879	15	0	"	17	0	..	..	..
1880	20	0	"	24	0	..	..	..
1881	17	0	"	21	0	..	..	..
1882	14	0	"	18	0	..	..	..
1883	13	0	"	18	0	..	..	..
1884	13	0	"	18	0	..	..	..
1885	12	0	"	17	0	..	..	..
1886	13	0	"	18	0	..	..	..
1887	14	0	"	22	0	..	..	..
1888	13	0	"	20	0	..	..	..
1889	13	0	"	18	0	..	..	..
1890	13	0	"	18	0	..	..	..
1891	12	6	"	18	0	..	..	..
1892	12	0	"	18	0	..	..	..
1893	12	0	"	17	0	..	..	..
1894	12	0	"	16	0	..	..	..
1895	12	0	"	16	0	..	..	..
1896	11	0	"	15	0	..	..	..
1897	11	0	"	14	0	..	..	..
1898	10	0	"	13	0	..	..	..
1899	10	0	"	13	0	..	..	..
1900	9	9	"	12	0	..	..	..
1901	9	0	"	10	0	..	..	..
1902	9	0	"	10	0	..	..	..
1903	10	0	"	12	0	..	..	..
1904	15	0	"	17	0	..	..	..
1905	17	0	"	20	0	..	..	..
1906	18	0	"	21	0	..	..	..
1907	*			*		..	..	..
1908	*			*		..	..	..
1909	*			*		..	..	..
1910	*			*		..	..	..
1911	*			*		..	..	..
1912	*			*		..	..	..
1913	*			*		..	..	..
1914	*			*		..	..	..
1915 †	*			*		..	..	..

EXHIBITION TRIAL OF MOTOR TILLAGE IMPLEMENTS

AT KING'S PARK FARM, STIRLING, OCTOBER 1915.

AN Exhibition Trial of Motor Tillage Implements was held by the Society at King's Park Farm, Stirling, on Tuesday and Wednesday, 5th and 6th October 1915.

The Trial was originally intended to be held in the autumn of 1914, but was postponed on account of the outbreak of war. The continuance of the war, and the fact that practically every British maker of Agricultural Motors was engaged on war work, rendered the organisation of the Trial somewhat difficult. The Directors of the Society felt, however, that circumstances demanded that no further delay should occur in holding the Trial. The scarcity of men and of horses, and the high price of the latter, had compelled landowners and farmers seriously to turn their attention to mechanical means of cultivating the soil, and there was a widely expressed desire to see available machines in operation. The large attendance of farmers and others interested in agriculture, from all parts of the country, on both days of the Trial, sufficiently testified to the widespread interest taken in the latest development of land cultivation.

The Committee in charge of the Trial were : Mr J. T. Mc'Laren, *Convener* ; Mr A. H. Anderson, Mr J. Mc'Hutchen Dobbie, Mr Thomas Elder, Mr David Ferrie, Dr R. Shirra Gibb, Mr J. Ernest Kerr, Mr H. M. Leadbetter, Mr W. T. Malcolm, Mr G. Bertram Shields, Mr R. C. Young, Mr Charles Douglas, D.Sc., *Chairman of Directors* ; Mr David Wilson, D.Sc., *Treasurer* ; Mr Alexander Cross, *Hon. Secretary* ; and Professor Stanfield, *Consulting Engineer*.

Site of Trial.

The Committee decided that it was desirable that the implements should be tested both on carse or clay soil, and on dryfield or light land. After visiting and inspecting various sites the Committee agreed that these conditions were excellently fulfilled by the fields on the King's Park Farm, Stirling, kindly placed at the disposal of the Society by the Messrs Dewar.

The carse field selected extended to about 15 acres, and was situated to the north of, and adjacent to, the Dumbarton and Stirling Public Road. This field was level, and consisted of a uniform stiff clay soil throughout. A crop of oats had been cut off the field, following Timothy-hay in 1914, and the field was to lie fallow in 1916.

The light-land field was situated about 200 yards distant from the carse field, and lay immediately to the west of the Castle, at the foot of the Castle Rock. It consisted of about $12\frac{1}{2}$ acres dryfield stubble, the soil being free and easily wrought. The field lay on a slope, and ploughing required to be done up and down. On four of the six plots laid out there was a sharp rise, varying from about 1 in 7 to 1 in 15, which, however, did not extend the full length of each ridge. To add to the severity of the test, the field, which was to be in early potatoes the following year, had dung spread on the face, in accordance with the usual practice. On the other two plots the gradient was considerably less, varying from 1 in 14 to 1 in 30, and on one of these plots no dung had been spread.

At the side of this field several stacks of oats were built, and the opportunity was thus provided for testing the capacity of the machines to drive a threshing-mill. The mill secured was an ordinary portable threshing-mill, by Burrell & Sons, Ltd., Thetford, with 4 ft. 6 in. drum, finishing, and straw-trussing appliances.

By the courtesy of Mr D. R. Cox, Road Surveyor for the Central District of Stirlingshire, two tractor waggons were placed at the disposal of the Society during the forenoon of the second day of the Trial, and facilities were provided at a quarry in the immediate vicinity for loading these up to any desired weight. The route selected for the haulage test included a gradient of 1 in 14.

Conditions and Regulations.

The general idea of the Committee was to provide tests for the motor implements which would, as nearly as possible, correspond to the actual conditions on a farm. Having provided these conditions, the Committee desired to leave each exhibitor free to demonstrate the best work of which his implement was capable, without imposing any restrictions as to the plough to be used or the number of furrows taken, the speed of the tractor on the land or on the road, or the weight of the load to be hauled. It was felt that at the present stage of development of agricultural motor implements the greatest service to the farmer would be secured by allowing each machine to demonstrate in its own way the best work of which it was capable.

The following regulation was, however, laid down by the Committee :—

“The depth of furrow shall be not less than 8 inches and not more than 10 inches on the light land, and not less than 6 inches on the stiff land.”

In addition to this, it was stated that in preparing the official Report on the Trial special attention would be directed to the following points :—

- (a) Weight of machine, and weight per inch width of wheel.
- (b) Mechanical design and construction.
- (c) Quality of work.
- (d) Time taken and attendance required.
- (e) Adaptability for ploughing different widths and depths.
- (f) Adaptability to various kinds of work, such as cultivating, and, in the case of tractors, harvesting, haulage, and the like.
- (g) Ease and safety of handling.
- (h) Ease of turning, and space and time required for same, and uniformity of furrow ends.
- (i) Facility of attachment—in the case of tractors.
- (j) Consumption of fuel and other supplies per unit of work done.
- (k) Price.

Prizes were not offered, but the Society paid the carriage and carting expenses of the implements to and from the Trial. The Society also provided the necessary fuel and lubricating oils.

Implements Entered.

The following implements, of which full descriptions will be found later, were duly entered for the Trial :—

1. 16 B.H.-P. Mogul Oil Tractor, by the International Harvester Co. of Great Britain, Ltd., 80 Finsbury Pavement, London, E.C.
2. 25 H.-P. Steam Tractor, by Mann's Patent Steam Cart and Wagon Co., Ltd., Pepper Road Works, Hunslet, Leeds.
3. “Sandusky” Petrol Tractor, 40/45 B.H.-P., by Messrs Mills & Sons, Ltd., Cambridge Place, Paddington, London, W.
4. “Overtime,” 24 B.H.-P. Paraffin-driven Tractor, by the Overtime Farm Tractor Co., 124/127 Minories, London, E.C.
5. “Bull Tractor,” 25 B.H.-P., by Messrs Cyrus Robinson & Co., Ltd., 61 Holland Road, London, W. (*Intimation was, however, received on the opening day of the Trial that this Tractor could not be sent forward for demonstration.*)

6. 11 B.H.-P. Motor Plough, by Wyles Motor Ploughs, Ltd.,
5 Carr Street, Manchester.

The Ivel Agricultural Motors, Ltd., entered a Tractor, but later were compelled to withdraw their entry on account of delay in completing machines under construction due to difficulty in obtaining delivery of raw materials.

Laying out of Ground.

The laying out of the ground was undertaken by a Sub-Committee, consisting of Messrs W. T. Malcolm, A. H. Anderson, and James McLaren. The carse field being of uniform quality throughout a ballot was not considered necessary. The Sub-Committee measured off a number of ridges for each implement, varying from six to ten, according to the number of furrows taken in each case. Feerings were drawn by a horse-plough in the usual manner. It was found necessary to stipulate that the implements adhere to the usual system of feerings and finishes, as otherwise the drainage arrangements peculiar to this kind of land would have been interfered with.

On the light land the order of the plots was balloted for, and thereafter the various areas were measured off, beginning at the south side of the field. In this case the extreme limits of each plot were indicated by furrows drawn by a horse-plough. Apart from these no feerings were drawn, and it was left to each exhibitor to plough his piece of ground in whatever manner he thought best suited to the peculiarities of his particular implement.

Official Observers.

The official observers appointed by the Society were: Mr John Edmond of Gallanuir, Bannockburn; Mr James Kidd, Mains of Errol, Errol; Mr James Walls, Muirton, Stirling; and Professor Stanfield, the Society's Consulting Engineer. Their report on the work done by the various machines is as follows:—

REPORT BY OFFICIAL OBSERVERS.

The general arrangements for the Trial were as follows:—

TUESDAY, 5th October.

Forenoon, 9 to 12—Ploughing on carse land.

Afternoon, 1.30 to 4.30—Ploughing on light land.

WEDNESDAY, 6th October.

Forenoon, 9 to 12—Threshing and Road Hauling.

Afternoon, 1.30 to 4.30—Ploughing on carse land.

The fields were laid off for six machines, but only five took part in the Trial, the exhibitors of the "Bull Tractor," Messrs Cyrus Robinson & Co., having intimated their inability to send a machine at the last moment.

Only two machines were ready to commence work at 9 o'clock on the first day—viz., the "Overtime" and the Wyles. The "Mogul" Tractor was on the field, but its plough had not arrived, although it started later, using another plough. The "Sandusky" Tractor was on the field, but its plough was not forward, and the Mann's Steam Tractor had not reached the field. All the machines were forward and ready to start in the afternoon, although in one case the plough did not reach Stirling until after the conclusion of the Trial.

It should be recorded that these delays were not in any way due to want of care or attention on the part of the exhibitors, but solely to the unavoidable congestion on the railways.

The various machines and the work done by them are dealt with according to the order in which they appeared in the Catalogue.

1. International Harvester Company of Great Britain, 16 B.H.-P. Mogul Oil Tractor—Price £265, rear wheel extension tyres £7, 10s. extra.

The motive power is obtained from a single cylinder slow speed oil-engine of simple construction. The cylinder has a diameter of 8 inches, with a stroke of 12 inches, the normal speed being 400 revolutions per minute. The valves are enclosed in easily removable cages, situated in the cylinder head, the exhaust valve being water-cooled; a compression relief cam is provided to facilitate starting. Steady running is ensured by an outside fly-wheel of substantial dimensions. The ignition is of the make-and-break type, the current being obtained from an oscillating type magneto—no batteries being required. The tank for holding the water for cooling the cylinder contains a five hours' supply. The transmission is of the planetary type, with one forward speed and a reverse—the gears are always in mesh and are thrown in or out of action by means of brake bands. The power is taken by a chain drive from the transmission to the rear axle, and the speed of the tractor may be changed by using different size sprockets. The differential is located on the large sprocket on the rear axle, and the differential casing is furnished with a large brake band and hand wheel for setting the tractor rigid when being used for driving machines through a belt. The belt driving pulley is 20 inches diameter and 10½ inches wide

on the face; it is fitted with a friction clutch, which enables the drive to be started gradually when the engine is running at normal speed.

The rear or driving wheels are 54 inches diameter by 10 inches across the face, and the front wheels 36 inches diameter and 6 inches wide.

The wheel-rims are made from specially rolled steel sections with reinforced edges; the spokes are flat and are riveted to the hubs and rims. By fitting extension tyres to the driving wheels the width of each wheel is increased to 15 inches. The tractor is 4 feet 8 inches wide over all, and 11 feet 3 inches long; it weighs $2\frac{1}{2}$ tons without the rear wheel extensions, which add 2 cwt. 2 qrs. to the weight.



Fig. 78.—*Mogul Oil Tractor.*

The engine is throttle-governed by a centrifugal governor running in oil.

The tractor is steered by a hand-wheel operating a non-reversible worm and sector gear. The frame is made of channel steel, and the side members are curved upwards over the front wheels so as to form an arch, which tends to absorb a greater part of the engine vibration.

This tractor is of simple construction, and all the working parts seem to be readily accessible for adjustments or repairs. The general design indicates strength and durability. The makers state that the engine works equally well on paraffin,

gas oil, solar oil, naphtha, or petrol, without change of adjustment.

The fuel used during the trials was ordinary Royal Day-light Oil, and the consumption was judged to be quite satisfactory.

The road speed is about 3 miles per hour, and the normal ploughing speed is 2 miles per hour; the tractor can be turned in a 16 feet circle.

The engine worked very well, and seemed to develop its full power, though occasionally there was a somewhat violent explosion in the silencer, which appeared to indicate that some adjustment was required.

This tractor did good rough ploughing on the carse land, using a Massey-Harris two-furrow plough of an old type, kindly lent to the Society by Messrs Kemp & Nicolson, Stirling. A Ransome's three-furrow plough had been ordered for use with this tractor, but unfortunately it did not arrive until after the conclusion of the Trial.

The tractor and plough required the attendance of two men. With a three-furrow plough the attendance would be economical. The combination appeared to be easily handled, and was turned at the ends with great rapidity, and in the space of an ordinary headland.

On the light land, on the less steep part of the field, this tractor and plough did fair work, although it seemed to be incapable of ploughing to the stipulated depth of 8 inches going uphill.

This tractor drove the threshing-mill with complete satisfaction. It also hauled a load of $5\frac{1}{2}$ tons, gross, over a prescribed course of about a mile, on the public road, including a gradient of 1 in 14. Although the pace was slow—about three miles an hour—the performance was quite satisfactory.

The official observers formed the opinion that, for all-round farm work, such as ploughing, cultivating, reaping, threshing, haulage, &c., this machine would be of great service to farmers.

2. Mann's Patent Steam Cart and Wagon Co., Ltd., 25 H.-P. Steam Tractor—Price £465.

The engine is of the horizontal compound type, with side-by-side cylinders 4 inches and $6\frac{3}{8}$ inches in diameter respectively; the stroke being 7 inches. The engine is mounted on the top of the boiler, which is of the locomotive type—designed for a working pressure of 200 lbs. per square inch—with firebox suitable for burning either coke or coal with side firing; a spark arrester is fitted in the smoke-box.

The feed tank has a capacity for 200 gallons of water—sufficient for about half a day's ploughing without replenishing.

There are three travelling speeds varying from 2 to 5 miles per hour, and compensating gear is provided for turning corners.

The total length of the tractor is 13 feet 2 inches, and the width over all is 6 feet. The total weight in working order is a little over 5 tons. The driving wheels are 51 inches diameter and 20 inches wide on the face; the front wheels, which are 35 inches diameter and 8 inches wide, do not track with those behind, but come inside, so that the weight is distributed over a large area, and the compression on the land is very small.

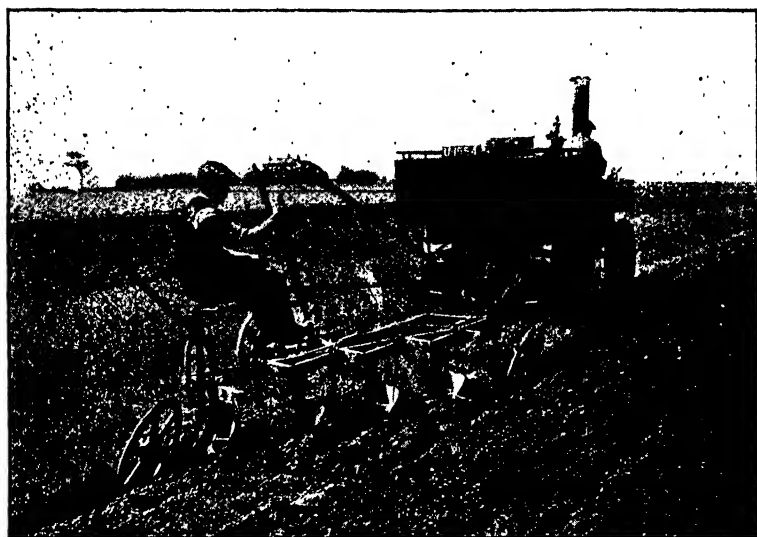


Fig. 79.—Mann's Light Steam Tractor and Plough.

A governor and a large fly-wheel are provided for driving threshing machinery with a belt.

About one cwt. of coal is considered to be sufficient to plough one acre of land.

This tractor is well designed and of strong construction; the depreciation of a motor of this type should be very small.

It is suitable for all kinds of stationary, field, and road work, and is very simple to manage; it is mounted on springs, to come under the Motor Cars Act.

This tractor and plough was not forward until the afternoon of the first day. On the light land the work done did not show to advantage. On the carse land, however, on the afternoon of the second day, the work done was very satisfactory. The plough used was a four-furrow one, and the work was accomplished very rapidly and without a hitch.

This tractor drove the threshing-mill, and took a load of 6 tons gross over the selected route without the slightest difficulty, and in a perfectly satisfactory manner.

The observers are of opinion that, in view of its comparatively light weight for a steam tractor, and its ease of handling and turning, this machine would be a desirable implement for a large farm. There can be no question as to its reliability.

3. Mills & Sons, Ltd., "Sandusky" 40/45 B.H.-P. Petrol Tractor—Price £577, 10s., complete with cleats, spuds, and extension rims.

This tractor is provided with a 4-cylinder vertical engine placed laterally across the frame. The cylinders are cast separately, the bore and stroke being 5 inches and $6\frac{1}{2}$ inches respectively, with a normal speed of 800 revolutions per minute. A governor is provided for speed regulation. Dual ignition by high-tension magneto and battery is fitted to facilitate easy starting. There is forced lubrication to the main crank shaft bearings, while the crank pin bearings, gudgeon pins, and pistons are lubricated on the splash system. Gauge glasses are provided for observing the flow of oil to the various parts.

The main drive from the engine is through a clutch and spur gear to the gear-box shaft. The gears provide for three speeds forward and a reverse; the lowest forward speed, corresponding to about 2 miles per hour, is a direct drive, and is generally used for ploughing work. The top speed is about $5\frac{1}{2}$ miles per hour. Spur gearing is also used between the gear-box and a differential countershaft. The final drive is also through spur gearing, the driving wheels having internal teeth fixed to their rims. The exhaust is directed against the teeth on the driving-wheel rim. Ample hand- and foot-operated brakes are fitted at the two ends of the differential countershaft and on to the differential casing; these are of assistance in manœuvring the tractor.

The driving wheels are 56 inches in diameter and 16 inches wide on the face; extension rims, each 10 inches wide, are also provided for the driving wheels. The front wheels are 36 inches in diameter and 5 inches wide.

The pulley for driving stationary machinery is placed on the end of the crank shaft, and is fitted with a free-wheel clutch to facilitate easy starting.

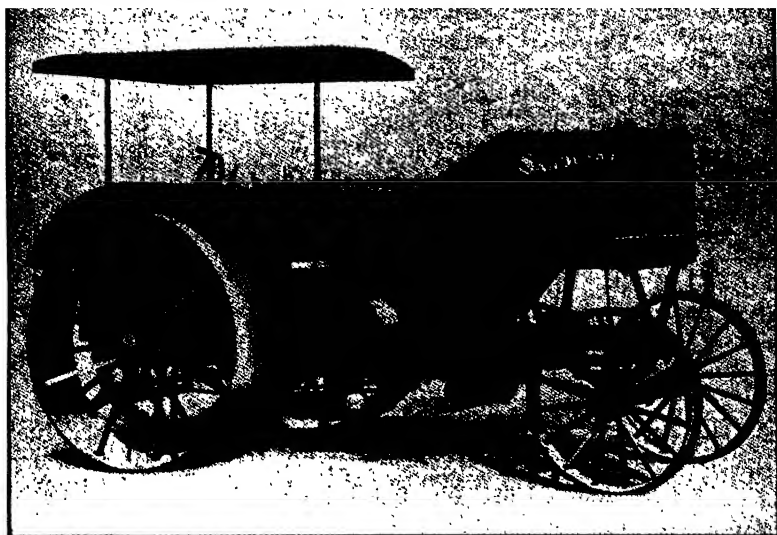


Fig. 80.—*Sandusky Petrol Tractor.*

The weight of the tractor is $3\frac{1}{2}$ tons, and the total length is about 12 feet.

The fuel used during the trials was Shell No. 2.

It is a strongly constructed and well-finished machine, and is very powerful.

The plough used with this tractor was a Grand De Tour plough, taking four furrows each 14 inches wide. The plough was controlled from the engine, so that tractor and plough were operated by one man. The width of the furrows was not adjustable, and the plough was found to be quite unsuited for the class of land on which the Trial took place. The exhibitor, it was understood, had made every endeavour to obtain a British-made plough, but without success, owing to the firms who make ploughs being fully engaged on war work. The tractor appeared to have ample power, and was well handled. With a suitable plough the observers see no reason why it should not perform good work on a large holding.

For the threshing this tractor took up its position very smartly and performed the work with complete satisfaction.

On the road it hauled a gross load of 6 tons with ease, its rate of travelling being considerably in excess of the other oil tractors.

The observers regret to be unable to report favourably on the field work of this tractor, owing to the causes above mentioned; but its threshing and hauling were performed in a very satisfactory manner.

4. Overtime Farm Tractor Co, "Overtime" 24 B H-P.
Paraffin-driven Tractor—Price £231.

The driving element consists of a two-cylinder horizontal engine fitted with valves in the cylinder covers. The cylinders are 6 inches bore and 7 inches stroke—speed 400 to 750 revolutions per minute. A centrifugal gear-driven governor is provided, and acts directly on the throttle. The speed at

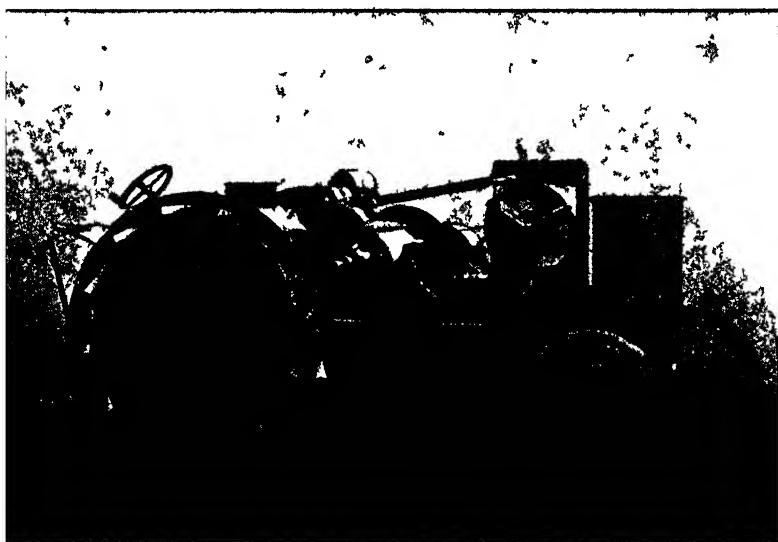


Fig 81.—"Overtime" Paraffin driven Tractor

which this governor operates is under the control of the driver, so that the speed of the engine can be adjusted to suit the work to be done.

The power is transmitted through a cone-clutch to a simple spur-gear of the sliding type, which provides one speed forward and a reverse. Spur-gearing is also used between the gear-box and the differential countershaft, and thence by pinion to toothed wheels on the hubs of the driving wheels. The

gears are in mesh only while the tractor is travelling, they are not in mesh when belt driving. The tractor speed is $2\frac{1}{2}$ miles per hour, but it may be varied by changing the speed of the engine.

Magneto ignition is provided with auxiliary batteries for starting.

The cooling water is circulated by a centrifugal pump through a honeycomb radiator, fitted with a belt-driven suction fan.

The driving wheels are 52 inches diameter and 10 inches across the face. The length of the tractor is 11 feet 11 inches, and the width is 6 feet. The weight is 4850 lb.

The drawbar is easily shifted, and is pivoted towards the front of the chassis, so as to permit of easy turning.

The pulley for driving stationary machines is placed on the end of the engine shaft, and is under the control of the engine clutch. By means of a catch working in conjunction with the clutch pedal, the clutch can be kept in the disengaged position when desired. The front wheels are set somewhat wide apart, and the steering is through chains, springs being fitted to take up any shock.

During the trials the engine ran on ordinary paraffin-oil, a little petrol being used at starting.

The engine worked very satisfactorily, and the exhaust was clean.

With this machine also the quality of the work done was undoubtedly influenced by the fact that suitable ploughs were unobtainable. On the carse land, with a three-furrow plough, the work done was of a very moderate description. On the less steep portion of the dryfield land, with a two-furrow plough, it showed to better advantage. The combination of tractor and plough did not appear to be easily handled. It required considerable attendance, and the space and time occupied in turning was more than in the case of any of the other machines.

This tractor drove the threshing-mill with complete satisfaction; and, in spite of the fact that the tyres of its driving wheels were practically plain, hauled a load of six tons over the prescribed course in a quite satisfactory manner. The pace was, however, slow—scarcely three miles per hour.

5. Wyles Motor Ploughs, Ltd., 11 B.H.-P. Motor Plough—
Price £172, 10s.

The motive power of this machine, which is fitted with a double furrow plough, is obtained from a single cylinder vertical petrol engine, with a bore of 5 inches and a stroke of 6 inches, the speed being 1000 revolutions per minute. The engine is well designed, the main bearings and the crank-pin bearing being of ample dimensions. The engine forms one complete unit with the gear-box, to which it is bolted, and the gear-box is carried upon the road wheels. All bearings apart from the engine are lubricated from the gear-box. The speed of the engine is entirely controlled by a governor, which operates the throttle, and is not capable of being interfered with by the driver. The carburetter provides for the opening and closing of the air-valve and the movement of a taper rod in the petrol jet to enlarge or decrease the area of the same, both of these operations being arranged to work with the throttle so as to ensure a constant mixture of air and petrol vapour under all conditions. High-tension magneto ignition is provided, and a switch is carried to the oil-tap, thus preventing the engine being started without turning on the oil. The water circulation is on the thermo-syphon principle, with a large radiator and fan.

The clutch is of the friction cone type, and the outer member forms the pulley for belt-driving; by using the clutch lever the pulley may be started and stopped as desired. The final drive is through spur gears to the road wheels. While ploughing, one wheel runs in the furrow and the other on the land; both wheels and the machine are, however, kept vertical.

The road wheels are so mounted that they can be adjusted in height in relation to the machine, the movement being radial with the driving-pinion, thus providing that the gears shall be in constant mesh.

The weight of the machine is sufficient to ensure that the engine and ploughs will sink between the wheels to the lowest position when the engine is at work. The reaction of the pinion teeth on the road wheel gear is sufficient to raise the machine between the wheels. This movement is obtained without the use of any special gearing, and is controlled by adjustable stops and pawls operating in a rack, the whole being brought under the control of the driver through one lever. By pushing this lever forward or drawing it back the machine is made to rise or fall. The machine may be tilted, the depth regulated, or the wheels set for starting ploughing and for finishing in the usual way.

Two speeds—corresponding to $1\frac{1}{2}$ and $2\frac{1}{2}$ miles per hour—are provided, and also positive clutches, which allow either wheel to be driven independently, and which enable the machine to be turned on one wheel as a pivot.

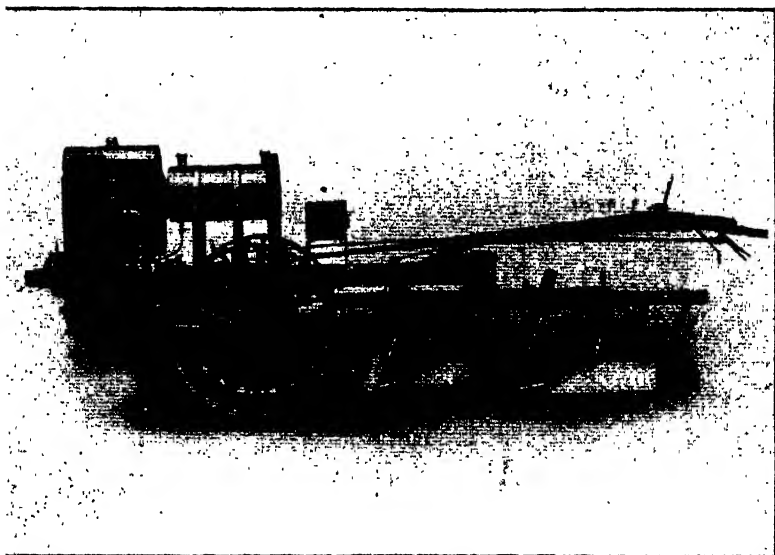


Fig. 82.—*Wyles Motor Plough.*

The construction of the machine provides for the usual implements being placed under the frame, the change being effected by the removal of a draw-pin.

The movements of the wheels provide for any ordinary depths, and variation in width is effected by removing the draw-pin and adjusting the width of the plough-frame in the usual manner.

In addition to ploughing, cultivating, &c., the motor can also be used for farm haulage work by the addition of a third wheel and steering-gear. For harvesting work a third wheel is added, making the machine a small tractor.

The usual farm implements may be driven by a belt from the pulley on the crank-shaft, but the engine is not sufficiently powerful for working a full-size threshing-machine.

The length of this machine is 12 feet 6 inches over all, the width is 2 feet 6 inches, and the weight, including ploughs, is 22 cwt.

The wheels are 33 inches in diameter and 7 inches wide.

The whole weight of the machine, including the ploughs, is balanced on the two wheels, thus ensuring that the maximum grip is obtained with a minimum land weight.

The fuel used during the trials was Shell No. 2.

The machine is exceedingly well-designed on sound practical lines. During the trials the engine worked very satisfactorily, and the consumption of petrol appeared to be low.

This plough did excellent work both on the carse land and on the light land. It required only one attendant, and was very easy and safe to handle. It takes two furrows, and is adjustable to plough at varying widths and depths. In turning, the space occupied was not greater than that required for a pair of horses. The furrow endings were very regular.

On the light land, although it had the smallest horse-power, it was the only implement which succeeded in pulling up the hill with two furrows, on the plot originally assigned to it. The gradient on the steepest part here varied from 1 in 10 to 1 in 21.

This machine is not adapted for threshing or road haulage. It is, however, fitted with a pulley, and might be used for driving some of the lighter farm machinery. The plough-shares can be replaced by a cultivator, and it is understood the machine can also be adapted to haul a binder or binders.

The official observers are of opinion that, taken all round, the field work of this machine was the best shown. They have confidence in recommending this implement to farmers as being well suited to do good work on moderate-sized farms.

Notes by Official Observers.

As already indicated, none of the tractors (Nos. 1, 2, 3, and 4) were successful in ascending the gradient on the plots originally assigned to them on the light land, and had to be removed to a part of the field where the gradient was less severe. The presence of a liberal dressing of fresh manure on the surface doubtless added to the difficulty.

This interruption of the work, and the late arrival of certain of the implements and ploughs, rendered it impossible to obtain an accurate record of fuel consumption, or of the amount of work performed during a given time.

The Official Observers are of opinion that the tractors are unable to do field work on a gradient exceeding 1 in 20.

Throughout the Trial the weather conditions were excellent. No rain had fallen for a considerable time, and the heavy land was in the most favourable condition. Under these circum-

stances the observers did not note any appreciable packing of the soil by the wheels of the tractors.

JOHN EDMOND.
JAMES KIDD.
JAMES WALLS.
R. STANFIELD, *Engineer.*

General Observations.

It is matter for regret that British makers of agricultural tractors were not more adequately represented at the Trial. The reason for their absence on this occasion is obvious, their whole output being required for military purposes.

Of the four tractors entered, three were of American construction. In preparing the above report, the Official Observers have necessarily dealt with the work of these implements as they saw it on the days of the Trial. In so far, however, as they have been unable to report favourably on the ploughing performed by these machines, it should be borne in mind that the fault lay mainly with the ploughs. There is no reason to assume that, at a future trial, with suitable ploughs attached, these machines would not give a good account of themselves.

The Committee are of opinion that, under the circumstances, the Trial cannot be regarded as in any way conclusive. The dislocation of trade, due to the present state of war, prevented many implements from being sent forward which otherwise would have been entered, and prevented some of those which did come forward from being shown to the best advantage. The late arrival of certain machines, and the impossibility of obtaining suitable ploughs, were due to the same cause, and although foreseen could not have been avoided.

At the same time, the Committee feel that the Trial has served a useful purpose in demonstrating the possibilities of mechanical power as applied to tillage and other farming operations, and as illustrating the variety and capacity of the implements at present available. The great interest shown by agriculturists throughout the country clearly proved the clamant need there is for such implements, and the Committee therefore feel that further Trials should be held by the Society.

J. T. M'LAREN,
Convener of Committee.

JOHN STIRTON,
Secretary.

PREMIUMS AWARDED BY THE SOCIETY IN 1915.

I.—VETERINARY DEPARTMENT.

CLASS EXAMINATIONS, 1915.

Silver Medals were awarded to the following :—

ROYAL (DICK) VETERINARY COLLEGE.

Chemistry	W. R. Wallace, Aberdeen.
Biology	W. R. Wallace, Aberdeen.
Junior Anatomy	W. R. Wallace, Aberdeen.
Senior Anatomy	W. S. Petrie, Careston.
Physiology, &c.	R. B. Crichton, Lisburn.
Stable Management	W. S. Petrie, Careston.
Pathology and Bacteriology	G. Howie, Alford.
Materia Medica and Therapeutics	J. D. Coutts, Kemnay.
Hygiene and Dietetics	G. Howie, Alford.
Veterinary Medicine and Surgery (Horse)	W. Harley, Hamilton.
Veterinary Medicine and Surgery (Ox, &c.)	J. Edgar, Whithorn.

GLASGOW VETERINARY COLLEGE.

Chemistry	James H. Motion, Devon Place, Alva.
Biology	James H. Motion, Devon Place, Alva.
Junior Anatomy	Thomas H. Michie, Alva.
Senior Anatomy	Robert R. Moodie, Rothesay.
Physiology	David G. Wishart, Kilmarnock.
Stable Management	David G. Wishart, Kilmarnock.
Materia Medica	John S. Keene, Glasgow.
Pathology	John S. Keene, Glasgow.
Hygiene	John S. Keene, Glasgow.

20 Large Silver Medals, £13, 15s.

II.—DISTRICT COMPETITIONS, 1915.

8 Districts—Grants of £12 each (Section I.) (less £3 not awarded)	£93 0 0
9 " Grants of £15 each (Section II.)	185 0 0
2 " Special Grants, including Edinburgh Agricultural Association, £100	103 0 0
13 " Medals for Shows (29 Large)	19 18 9
1 " Medal for Hoeing Competition	0 5 1
63 " Medals for Ploughing, 1914-15	16 0 1
97 Long Service Certificates, £27, 10s. 4d., and Medals, £21, 16s. 6d. (1914-15)	49 6 10
	<u>£416 10 9</u>

ABSTRACT OF PREMIUMS.

District Competitions	£367 8 11
Long Service Awards	49 6 10
Veterinary Colleges	13 15 0
	<u>£430 5 9</u>

STATE OF THE FUNDS

OF

THE HIGHLAND AND AGRICULTURAL SOCIETY OF SCOTLAND

As at 30th NOVEMBER 1915

I. INVESTED IN WAR STOCK, HERITABLE BONDS, DEBENTURE AND PREFERENCE RAILWAY STOCKS, BANK STOCKS, &c.	£95,648 17 8
II. ESTIMATED VALUE of Building, No. 3 George IV. Bridge	£3,100 0 0
III. ESTIMATED VALUE of Furniture, Paintings, Books, &c.	1,000 0 0
	4,100 0 0
IV. ARREARS OF SUBSCRIPTIONS considered recoverable	210 14 6
V. BALANCES as at 30th November 1915 on Account Current with ROYAL BANK OF SCOTLAND	817 19 5
AMOUNT OF GENERAL FUNDS	<u>£100,777 11 7</u>
VI. SPECIAL FUNDS—	
TWEEDDALE MEDAL FUND—	
Heritable Bond, at 4½ per cent	£500 0 0
FIFE AND KINROSS PERPETUAL GOLD CHALLENGE CUP FUND—	
£460 Great Central Railway Co. 3½ per cent Second De-	
benture Stock	400 0 0
PAISLEY GOLD CUP FUND—	
£802, 8s. 8d. North British Railway Co. 3 per cent De-	
benture Stock	600 0 0
RENFREWSHIRE GOLD CUP FUND—	
£668, 14s. 4d. North British Railway Co. 3 per cent De-	
benture Stock	500 0 0
WILLIAM TAYLOR MEMORIAL PRIZE FUND—	
£401, 2s. 7d. North British Railway Co.	
3 per cent Debenture Stock	£300 0 0
Sum on Deposit Receipt with British Linen	
Bank, being Income for 1915 not expended	10 7 10
	310 7 10
AMOUNT OF SPECIAL FUNDS	<u>£2810 7 10</u>

DAVID WILSON, *Treasurer.*

CHARLES M. DOUGLAS, *Chairman of Directors.*

WM. HOME COOK, C.A., *Auditor.*

EDINBURGH, 12th January 1916.

ABSTRACT of the ACCOUNTS of the HIGHLAND and CHARGE.

1. BALANCES due by Royal Bank of Scotland on Account Current			
at 30th November 1914			£3,120 15 6
ARREARS of Subscriptions outstanding at 30th November 1914			
			£168 3 6
Whereof due by Members who have compounded for life, and whose arrears are thereby extinguished			
	£4 13 6		
Sums ordered to be written off	65 7 6		
		70 1 0	
			98 2 6
3. INTERESTS AND DIVIDENDS—			
(1) Interests—			
On Heritable Bonds, less Income-tax	£621 12 2		
On Railway Debenture and Preference Stocks, do.	1,544 11 6		
On Colonial Government Stocks, do.	368 19 3		
On Annuity Stocks, do.	63 6 4		
On Deposit Receipts, do.	27 5 0		
	£2,625 14 3		
(2) Dividends—			
On Consols, less Income-tax.	£116 5 7		
On Bank Stocks, do.	1,081 16 7		
		1,198 2 2	
			3,823 16 5
4. SUBSCRIPTIONS—			
Annual Subscriptions	£1,572 14 0		
Life Subscriptions	590 11 0		
			2,163 5 0
5. TRANSACTIONS			
			33 15 3
6. INCOME-TAX REPAID for year to 5th April 1915			
			314 10 0
7. RECEIPTS in connection with former Shows—			
1. Hawick Show } forfeited prizes {	£8 10 0		
2. Paisley Show }	5 0 0		
			13 10 0
8. DONATION to Funds by Fife Agricultural Society			
			5 5 0
9. INVESTMENTS REALISED			
			5,201 12 1
10. RECEIPTS in connection with Edinburgh Show, 1915 (postponed)			
			80 5 10
SUM OF CHARGE			£14,854 17 7

AGRICULTURAL SOCIETY of SCOTLAND for the Year 1914-1915.

DISCHARGE.

1. ESTABLISHMENT EXPENSES—			
Salaries and Wages—Secretary, £600; Chief Clerk, £350; Second Clerk, £152, 15s. 6d.; Typist, £65; Messenger, £72, 0s. 8d.; Retiring Allowance to Messenger, £52; Clerical Assistance, £66, 10s.			£1,358 6 1
Fou-duty, £28; Taxes, £61, 14s. 6d.			89 14 6
Coals, Gas, Electric Light, &c.			83 7 5
Repairs and Furnishings, £83, 13s. 5d.; Telephone and Telegrams, £18, 0s. 9d.; Insurance, £34, 16s.; Pension Annuities, £35, 16s.			222 15 2
			<hr/>
			£1,704 8 2
2. FEE to Auditor of Accounts for 1913-1914			75 0 0
3. EDUCATION—			
Forestry Examination		£26 3 0	
National Diploma in Agriculture		68 10 11	
National Diploma in Dairying		54 9 7	
			<hr/>
			149 3 6
4. CHEMICAL DEPARTMENT—			
Fee to Chemist		£50 0 0	
Analyses to Members and Expenses		105 9 0	
Printing		3 15 6	
			<hr/>
			159 4 6
5. VETERINARY DEPARTMENT—			
Silver Medals awarded to Students			13 15 0
6. BOTANICAL AND ENTOMOLOGICAL DEPARTMENT—			
Fee to Botanist for year		£25 0 0	
Testing Seeds for Members		1 10 0	
			<hr/>
			26 10 0
7. SOCIETY'S TRANSACTIONS			962 14 9
8. ORDINARY Printing, £77, 14s. 3d.; Advertising, £61, 6s. 4d.; Stationery, Books, &c., £74, 9s. 8d.; Postages, £75; Bank Charges, &c., £6, 17s. 11d.			295 8 2
9. FEE to Consulting Engineer			75 0 0
10. GRANTS to Public Societies.			25 0 0
11. MISCELLANEOUS			116 9 8
12. INVESTMENTS made			7,376 9 3
13. SPECIAL Grants—			
Prince of Wales National Relief Fund		£1000 0 0	
Edinburgh Agricultural Association		100 0 0	
			<hr/>
			1,100 0 0
14. PAYMENTS in connection with Hawick and Paisley Shows			169 10 0
15. PAYMENTS in connection with Edinburgh Show, 1915 (postponed)			176 1 8
16. PREMIUMS and Medals for Local Shows and District Competitions			415 10 7
17. CERTIFICATES and Medals for long service			139 11 11
18. EXPENSES in connection with Trial of Improved Potato-Planters			43 15 5
19. Do. do. Motor Implements			226 6 7
20. ARREARS of Subscriptions struck off as irrecoverable			76 9 6
21. ARREARS outstanding at 30th November 1915			210 14 6
22. BALANCES at 30th November 1915 with Royal Bank of Scotland on Current Account—			
Edinburgh Account		£810 19 5	
London Account		74 0 0	
			<hr/>
			817 19 5
SUM OF DISCHARGE			<hr/>
			£14,854 17 7

DAVID WILSON, *Treasurer.*

CHARLES M. DOUGLAS, *Chairman of Directors.*

WM. HOME COOK, C.A., *Auditor.*

ABSTRACT of the ACCOUNTS of the

CHARGE.

I. FUNDS as at 30th November 1914—			
Amount on Heritable Bond at 4 per cent			£3,500 0 0
£3,193, 6s. 8d. North British Railway Company 3 per cent			
Debenture Stock, purchased at			2,650 0 0
£550 Lancashire and Yorkshire Railway Company 3 per cent			
Debenture Stock, purchased at			611 10 6
£500 Queensland 3½ per cent Inscribed Stock, 1950-70, purchased at			450 1 0
£190 London and North-Western Railway Company 4 per cent			
Guaranteed Stock, purchased at			259 1 11
			<hr/>
			£7,470 13 5
BALANCE on Account Current with Royal Bank of Scotland			289 17 7
			<hr/>
			£7,760 11 0
II. INTEREST ON INVESTMENTS—			
On £3,500 on Heritable Bond at 4 per cent, for year to Martinmas 1915		£140 0 0	
Less tax		19 2 8	
		<hr/>	£120 17 4
On £3,193, 6s. 8d. North British Railway Company 3 per cent			
Debenture Stock for year	£95 16 0		
Less tax	13 1 8		
	<hr/>		82 14 4
On £550 Lancashire and Yorkshire Railway Company 3 per cent			
Debenture Stock for year	£16 10 0		
Less tax	1 12 4		
	<hr/>		14 17 8
On £500 Queensland 3½ per cent Inscribed Stock, 1950-70, for year	£17 10 0		
Less tax	2 0 0		
	<hr/>		15 10 0
On £190 London and North-Western Railway Company 4 per cent Guaranteed Stock for year	£7 12 0		
Less tax	0 15 1		
	<hr/>		6 16 11
On £180 lent to Edinburgh Corporation from 9th March 1915 to 11th November 1915	£3 11 10		
Less tax	0 10 7		
	<hr/>		3 1 3
			<hr/>
			243 17 6
III. INCOME TAX repaid for three years to 5th April 1915			47 15 2
			<hr/>
SUM OF CHARGE			£8,052 3 8
			<hr/>

EDINBURGH, 12th January 1916.

ARGYLL NAVAL FUND for Year 1914-1915.**DISCHARGE.**

I. ALLOWANCES to the six following Recipients—			
Francis Grant Hunter (tenth year)	.	.	£40 0 0
H. R. Gordon Cumming (fifth year)	.	.	40 0 0
M. H. Hopkins (fourth year)	.	.	40 0 0
E. M. C. Parker (second year)	.	.	40 0 0
J. K. D. Hutchison (first year)	.	.	40 0 0
Keith M. G. Campbell (special grant)	.	.	20 0 0
			<hr/>
			£220 0 0
II. ADVERTISING Expenses			
	.	.	7 1 1
III. INVESTMENT made—			
Loan to Edinburgh Corporation at $\frac{1}{2}$ per cent above Deposit			
Receipt Rates, dated 10th March 1915	.		£180 0 0
			<hr/>
IV. FUNDS as at 30th November 1915—			
Amount on Heritable Bond at 4 per cent	.	£3,500	0 0
£3,193, 6s. 8d. North British Railway Company			
3 per cent Debenture Stock, purchased at	.	2,650	0 0
£550 Lancashire and Yorkshire Railway Com-			
pany 3 per cent Debenture Stock, purchased			
at	.	611	10 6
£500 Queensland $3\frac{1}{2}$ per cent Inscribed Stock,			
1950-70, purchased at	.	450	1 0
£190 London and North-Western Railway Com-			
pany 4 per cent Guaranteed Stock, purchased			
at	.	259	1 11
Temporary loan with the Corporation of Edin-			
burgh	.	180	0 0
			<hr/>
		£7,650	13 5
Balance on Account Current with Royal Bank			
of Scotland	.	174	9 2
			<hr/>
			7,825 2 7
			<hr/>
SUM OF DISCHARGE	.		£8,052 3 8
			<hr/>

DAVID WILSON, *Treasurer.*CHARLES M. DOUGLAS, *Chairman of Directors.*WM. HOME COOK, C.A., *Auditor.*

**STATE OF RECEIPTS AND PAYMENTS in connection with
the Edinburgh Show, 1915 (postponed).**

RECEIPTS.

INTEREST from Special Cup, &c., Funds—				
Fife and Kinross Gold Cup	.	.	.	£14 10 6
Renfrewshire Gold Cup	.	.	.	17 6 5
Paisley Gold Cup	.	.	.	20 15 9
Tweeddale Gold Medal	.	.	.	17 5 4
William Taylor Memorial	.	.	.	10 7 10
SUM OF RECEIPTS				<u>£80 5 10</u>

PAYMENTS.

1. PRINTING—				
Wm. Blackwood & Sons	.	.	.	£30 1 3
2. ADVERTISING—				
Henry Munro, Limited, commission on cancelled advertisements	.	.	.	£21 0 0
Do. do. advertising	.	.	.	2 12 8
				<u>23 12 8</u>
3. REPLICA CUPS—				
Fife and Kinross Cup	.	.	.	£14 10 6
Paisley Cup	.	.	.	20 15 9
Renfrewshire Cup	.	.	.	17 6 5
				<u>52 12 8</u>
4. ROSETTES, Storage, &c., and Insurance—				
Mrs E. Arnott for rosettes	.	.	.	£25 11 3
T. Gibson & Son, storing and repairing turn-stiles	.	.	.	12 12 0
M'Andrew & Co., storing and insurance of plant	.	.	.	8 5 0
N. B. Mercantile Insurance Co., insurance of—				
Gold Cups—Burglary	.	.	.	£4 5 0
Do. —Fire	.	.	.	2 2 6
Staff	.	.	.	1 11 6
				<u>7 19</u>
				<u>54 7 3</u>
5. POSTAGES	.	.	.	5 0 0
INCOME from W. Taylor Memorial, transferred to Fund Account				10 7 10
SUM OF PAYMENTS				<u>£176 1 8</u>

ABSTRACT.

Amount of Receipts transferred to Ordinary Account	.	.	.	£80 5 10
Amount of Payments do. do.	.	.	.	176 1 8
BALANCE OF PAYMENTS				<u>£95 15 10</u>

DAVID WILSON, *Treasurer.*

CHARLES M. DOUGLAS, *Chairman of Directors.*

WM. HOME COOK, C.A., *Auditor.*

EDINBURGH, 12th January 1916.

VIEW OF RECEIPTS AND PAYMENTS
For the Year 1914-1915.

RECEIPTS.

1. ANNUAL SUBSCRIPTIONS AND ARREARS received	£1,383	12	6
2. LIFE SUBSCRIPTIONS	590	11	0
	<hr/>		
	£1,974	3	6
3. INTERESTS AND DIVIDENDS—			
Interests	£2,625	14	3
Dividends	1,198	2	2
	<hr/>		
	3,823	16	5
4. TRANSACTIONS	33	15	3
5. INCOME-TAX repaid for year to 5th April 1915	314	10	0
6. PRIZES FORFEITED, &c. (Paisley and Hawick Shows)	13	10	0
7. DONATION to Funds by Fife Agricultural Society	5	5	0
8. RECEIPTS in connection with Edinburgh Show, 1915 (postponed)	80	5	10
	<hr/>		
SUM OF RECEIPTS	£6,245	6	0

PAYMENTS.

1. ESTABLISHMENT EXPENSES—			
Salaries and Wages	£1,358	6	1
Fou-duty, Taxes, Coals, Gas, Repairs, and Furnishings, &c.	345	17	1
	<hr/>		
	£1,704	3	2
2. FEE TO AUDITOR of Accounts for 1913-1914	75	0	0
3. EDUCATION	149	3	6
4. CHEMICAL DEPARTMENT	159	4	6
5. VETERINARY DEPARTMENT	13	15	0
6. BOTANICAL AND ENTOMOLOGICAL DEPARTMENT	26	10	0
7. SOCIETY'S TRANSACTIONS	962	14	9
8. ORDINARY Printing, Advertising, Stationery, Books, &c., Postages, Bank Charges, &c.	295	8	2
9. FEE to Consulting Engineer	75	0	0
10. GRANTS to Public Societies	25	0	0
11. MISCELLANEOUS	116	9	8
12. SPECIAL GRANTS	1,100	0	0
13. PAYMENTS in connection with Hawick and Paisley Shows	169	10	0
14. PAYMENTS in connection with Edinburgh Show, 1915 (postponed)	176	1	8
15. PREMIUMS for Local Shows and District Competitions	415	10	7
16. CERTIFICATES AND MEDALS for Long Service	139	11	11
17. EXPENSES in connection with Trial of Improved Potato-Planters	43	15	5
18. EXPENSES in connection with Trial of Motor Implements	226	6	7
Sum of Payments	<hr/>		
	5,873	4	11
BALANCE OF RECEIPTS	<hr/>		
	£372	1	1

DAVID WILSON, *Treasurer.*
CHARLES M. DOUGLAS, *Chairman of Directors.*
WM. HOME COOK, C.A., *Auditor.*

EDINBURGH, 12th January 1916.

PROCEEDINGS AT BOARD MEETINGS.

MEETING OF DIRECTORS, 3RD MARCH 1915.

Mr CHARLES DOUGLAS, D.Sc., of Auchlochan, in the Chair.

Present.—*Vice-President*—Major F. J. Carruthers. *Ordinary Directors*—Mr George W. Constable; Mr John M'Hutchen Dobbie; Mr Charles Douglas, D.Sc.; Mr William Elliot; Colonel G. J. Fergusson-Buchanan; Sir Archd. Buchan Hepburn, Bart.; Mr Hugh M. Leadbetter; Mr William MacDonald; Mr Peter MacIntyre; Mr James M'Laren; Mr R. Macmillan; Mr James M'Queen; Mr John C. Robertson; Mr George Bertram Shields; Mr Duncan Stewart; Mr D. A. Stewart; Sir Hugh Shaw Stewart, Bart.; Mr R. D. Thom. *Extraordinary Directors*—Mr A. H. Anderson; Mr James I. Davidson; Mr Thomas Elder; Mr David Ferrie; Dr R. Shirra Gibb; Mr William T. Malcolm; Mr James Wylie. *Treasurer*—Mr David Wilson, D.Sc. *Hon. Secretary*—Mr Alexander Cross. *Chemist*—Mr J. F. Tocher, D.Sc. *Engineer*—Professor Stanfield. *Auditor*—Mr Wm. Home Cook, C.A.

Medals for Ploughing Matches.

A letter was read from the Secretary of the Beith Ploughing Society stating that, owing to a large number of the young men in the district being absent on military duty with the Ayrshire Yeomanry, only eight competitors had taken part in the competition this year, and asking if, under these circumstances, the usual medal would be awarded. The minimum number of competitors required by the regulations is twelve.

It was unanimously agreed that a medal be awarded as usual; and the Secretary was instructed that this decision should apply to all similar cases.

Edinburgh Show, 1915.

Grant by Edinburgh Town Council.—A letter was read from Sir Thomas Hunter, Town Clerk, intimating that the Magistrates and Council had voted a sum of four hundred guineas (£420) to the funds of the Show.

The Secretary was instructed to convey to the Town Council the cordial thanks of the Directors for the handsome donation.

Proof of Prize List.—The Prize List and Regulations for the Edinburgh Show was submitted in proof and generally approved of.

Suffolk Sheep.—A letter was read from the Secretary of the Suffolk Sheep Society, stating that the Council of the Society would now be willing to offer an additional £10, as well as a £20 Challenge Cup previously offered. The Board had already accepted a grant of £20 and allocated it in money prizes.

It was agreed that it would not be advisable to make any alteration in the Prize List as at present arranged for this year.

Aberdeen-Angus Cattle.—A letter was read from the Secretary of the Aberdeen-Angus Cattle Society, stating that the Council of the Society did not wish any alteration made in the classification of these cattle, to permit of two-year-old animals which had had a calf being shown along with the heifers instead of with the cows.

British Holstein Cattle.—At the request of the Breed Society it was agreed that in future the designation of these cattle be "Holstein-Friesian" instead of "British Holstein."

Blackface Wool.

A letter was submitted from the Board of Agriculture for Scotland transmitting copy of a letter, dated 13th February 1915, from the Board of Trade to the Under-Secretary for Scotland, intimating that arrangements had been made to license, subject to certain conditions, the exportation to neutral countries of a considerable proportion of the Blackface clip.

On the motion of the CHAIRMAN it was agreed to thank the Board of Agriculture for Scotland for their action in the matter.

Mr GEORGE W. CONSTABLE submitted samples of khaki cloth which had been made in Peeblesshire from pure Blackface wool, and in the manufacture of which the entire fleeces had been used and not merely selected portions. He suggested that the Board should use its influence with the War Office to get them to make use of this cloth for military purposes. The Chairman, however, pointed out that representations to this effect had already been made, and not without success.

Potato Planter Trial.

A Minute of Meeting of the Implement Trials Committee, dated 3rd March, was read and approved.

The Minute stated that six machines had been entered for the forthcoming Trial of Potato Planters on 25th March, and recommended (1) that the following gentlemen be appointed to scrutinise the work of the planters and prepare an official report thereon: Mr T. Blair, Hoprig Mains; Mr George Dun, Woodmill, Auchtermuchty; Mr James Wilson, Westburn, Cambuslang; and Professor Stanfield, the Society's Consulting Engineer; (2) that the following Sub-Committee be entrusted with the carrying out of the necessary arrangements: Mr J. T. M'Laren, *Convener*, Mr J. M'Hutchen Dobbie, and Mr G. B. Shields, along with Mr Robin Welsh, the tenant of Liberton Mains, where the trial is to take place.

Veterinary Examination of Horses.

The following Report of the Committee on the above subject, dated 3rd February, was submitted:—

"The Committee are of opinion that the Society should undertake the Veterinary examination of horses exhibited at the Annual Show, and recommend to the Board of Directors as follows:—

"1. That a beginning be made by examining the Stallions of all ages and of all breeds.

"2. That the fact that the animal's name appears on the Register of the Board of Agriculture and Fisheries or the Board of Agriculture for Scotland for the current year be accepted in lieu of examination.

"3. That all Competitors in the Stallion Classes be examined before being judged, and no animal found to be unsound be allowed to compete.

"4. That it be remitted to this Committee to prepare a panel of Veterinary Surgeons from which the Veterinary Inspectors each year should be chosen.

"5. That in order to carry the foregoing recommendations into effect, the following new Rule be added to the Society's Show Regulations:—

"No Stallion or Colt shall be allowed to compete for any of the Society's Prizes 'until it has been certified free from hereditary unsoundness by a Veterinary Surgeon appointed for that purpose by the Society, except in those cases where the name of the animal appears on the Register of Stallions for the current year of the Board of Agriculture and Fisheries or the Board of Agriculture for Scotland.'"

Mr LEADBETTER, Steward of Horses, drew attention to certain practical difficulties in carrying out the provisions of the Report. These related to the time that would be required for carrying out the inspection, as horses did not require to be in the Showyard until 8 A.M., and the judging commenced at 9.30; to the number of veterinary inspectors that would be required; and to the retention in the Showyard of horses that had been rejected.

Mr MALCOLM concurred in drawing attention to these difficulties, and further pointed out that there might be a difficulty in dealing with horses which might be present in the Showyard which had previously been rejected by the Inspectors of the Board of Agriculture.

The CHAIRMAN said that the views of Mr Leadbetter and Mr Malcolm were not inconsistent with the provisions of the Report, but merely showed that the adoption of the Report must be followed by the framing of regulations in detail for carrying out the examination.

The Report was accordingly, on the motion of Mr ALEXANDER CROSS, approved, and it was remitted to the Committee to frame the necessary regulations.

Mr W. T. Malcolm was added to the Committee.

Catering in Showyard.

A Minute of Meeting of Catering Committee, dated 3rd March, was read and approved.

The Minute recommended (1) that there be four licensed refreshment booths in the Showyard, the caterers in these to be John Mitchell, Union Buildings, Aberdeen (Committee Booth); John Brodie, Cross Keys Hotel, Dalkeith; Thomas White, Ltd., 7 and 9 Gordon Street, Glasgow; John Smith & Sons, 84 Gordon Street, Glasgow; (2) that in one of the refreshment booths a somewhat more expensive luncheon be served, at a charge of 3s. 6d., on the Tuesday and Wednesday. In the other three booths the usual luncheons at 2s. 6d. will be provided on the Tuesday and Wednesday. After 3 o'clock, however, on these days, and all day on Thursday and Friday, meals will be provided according to a fixed tariff for each course, the 2s. 6d. rate being suspended; and (3) that the attention of Stand-holders be again drawn to the Society's regulation prohibiting the giving of alcoholic drinks to visitors, and pointing out that the regulation will be strictly enforced.

Cross-bred Cattle.

A Minute of Meeting of Committee appointed to consider the steps to be adopted for encouraging the breeding of Cross-bred Cattle was submitted and approved.

The Minute recommended (1) that the Directors intimate that they are prepared to consider applications in respect of District Competitions from Local Societies which desire to use their grants as prizes for Cross-bred calves and year-old cattle; and (2) that the following note be inserted in the Premium Book, under District Competitions, Class II., p. 44: "Exceptions to this rule may, however, be authorised by the Directors on application."

The Committee was continued with the view of giving further consideration to this subject.

Election of Office-bearers.

The CHAIRMAN submitted a verbal statement of the findings arrived at by the Committee appointed to report on the Showyard Resolution regarding the Election of Office-bearers. He said the Committee thought it right to prepare the Report in draft, and in order to give the Directors the fullest opportunity for consideration it was proposed to send a copy to each Member of the Board at an early date. The Draft Report would therefore come up for consideration at next Meeting of the Board.

Edinburgh Show Buildings.

A letter from the Society's Showyard Contractors regarding the use of corrugated iron instead of wood for the boundary fence was submitted. It was agreed that it would not be advisable to use corrugated iron for those parts of the boundary fence which were adjacent to the stables, but that in other parts this material might be used.

New Entrance Gates.

Plans and estimates for a new Entrance Structure were submitted by Professor Stanfield. It was agreed, in view of the abnormal cost of material, to delay proceeding with this new structure at the present time, providing it was found that the use of the old structure could be retained for another year.

On the general question of proceeding with the erection of the Showyard some discussion took place, and the Chairman stated what steps he had taken to ascertain the views of the War Office on the question of the advisability of holding the Show. It was eventually agreed that the Chairman be asked to call a Special Meeting of the Directors on 17th March, or such other date as he might find more convenient, to consider the question in the light of the replies he might receive from the War Office and the Railway Companies.

MEETING OF DIRECTORS, 7TH APRIL 1915.

Mr CHARLES DOUGLAS, D.Sc., of Auchlochan, in the Chair.

Present.—*Vice-President*—Major F. J. Carruthers. *Ordinary Directors*—Mr George Bean; Mr Walter Biggar; Mr John M'Hutchen Dobbie; Mr Charles Douglas, D.Sc.; Mr William Elliot; Sir Archd. Buchan Hepburn, Bart.; Mr Hugh M. Leadbetter; Mr John M'Caig; Mr William MacDonald; Mr Peter MacIntyre; Mr James M'Laren; Mr Robert Macmillan; Mr James M'Queen; Mr O. H. Scott Plummer; Mr John C. Robertson; Mr George Bertram Shields; Mr Duncan Stewart; Sir Hugh Shaw Stewart, Bart.; Mr R. D. Thom; Mr R. C. Young. *Extraordinary Directors*—Mr James Allison; Mr A. H. Anderson; Mr James I. Davidson; Mr John Edmond; Mr Thomas Elder; Mr David Ferrie; Dr R. Shirra Gibb; Mr James A. Hunter; Mr J. Ernest Kerr; Mr J. T. M'Laren; Mr William T. Malcolm; Mr John M. Martin; Mr James Wylie. *Honorary Secretary*—Mr Alexander Cross. *Engineer*—Professor Stanfield. *Auditor*—Mr William Home Cook, C.A.

(*In Committee.*)

Edinburgh Show, 1915.

The CHAIRMAN intimated the results of the inquiries which he had addressed to the Military Authorities and the Caledonian Railway Company.

Mr M'HUTCHEN DOBBIE moved that the Annual Show, arranged to be held in Edinburgh this year, be not proceeded with.

Mr C. H. SCOTT PLUMMER seconded.

Mr W. T. MALCOLM moved as an amendment that the Show be proceeded with.

Mr GEORGE BRAN seconded.

A discussion followed, which was taken part in by Sir Archibald Buchan-Hepburn of Smeaton, Bart., Mr Thomas Elder, Mr J. Inglis Davidson, and Dr R. Shirra Gibb.

On a division the motion was carried by a large majority, only six votes being recorded in favour of the holding of the Show.

It was agreed to consider at next Meeting of the Board the effect this decision would have on the previous resolutions to hold the Shows of 1916 at Aberdeen, and 1917 at Stirling.

(*The Board then met in Public.*)

Edinburgh Show, 1915.

The CHAIRMAN announced that the Directors, meeting in Committee, had decided, in view of all the circumstances, not to proceed with the Show arranged to take place in Edinburgh this year.

Nomination of Directors.

The SECRETARY submitted the usual Report of Meetings of Members held in the various Show districts for the nomination of Directors.

Potato Planter Trials.

A Minute of Meeting of the Implement Trials Committee, dated 7th April, was read and approved.

The Minute recommended that the Report on the Trials by the Official Observers, which was laid on the table, should be issued at once to the Press, and should not be withheld until the publication of the volume of 'Transactions,' in which it would also appear.

On the motion of the CHAIRMAN, the cordial thanks of the Board were conveyed to the Official Observers for their services and Report; to Mr Robin Welsh, Liberton Mains, for the use of the field and for the complete arrangements which he had made; and to the Committee for the efficient manner in which the Trials were carried through.

Forestry Examination.

The SECRETARY submitted the Report on the results of the recent Examination in Forestry held by the Society.

Election of Office-bearers.

THE CHAIRMAN, as Convener, submitted the Report of the Committee appointed to consider the Showyard Resolution of July 1914 regarding election of Office-bearers. In moving its adoption he expressed the hope that the Report would be accepted as a reasonable settlement of a question which, he ventured to think, had occasioned too much controversy in the past, and which it was very desirable in the interests of the Society should be brought to a close.

MR THOMAS ELDER, Stevenson Mains, seconded, and the Report was duly approved.

Report by Committee.—The Resolution instructs the Directors (a) to consider the advisability of submitting nominations of office-bearers to the Meeting in the Showyard, and (b) if so advised, to suggest necessary amendments to the Bye-laws.

I. As to (a), the Board may recommend this change, or report against it. It may, alternatively, report generally without submitting a recommendation.

II. It may, if it recommends the change, or submits no recommendation, report on (b) the amendments of Bye-laws which will be necessary if the proposed change be carried out.

As to the first question, the Committee can only call attention to the obvious reasons for and against the proposed change. On the one hand, it is evident that a much larger meeting is obtainable in the Showyard than is usually obtained elsewhere. On the other hand, such a meeting must generally be disproportionately representative of the members resident in the Show Division in which it is held.

No other important considerations present themselves, and the question is merely one of choice between the advantages indicated. In the opinion of the Committee, the Directors would do well to leave the choice to be made by the members of the Society at a General Meeting rather than to urge any preference that they may severally or collectively entertain. The Committee suggest that any change that may be made should apply only to the nominations of Extraordinary Directors, who are nominated solely by the Board, and not to those of Ordinary Directors, who are nominated by the Show Divisions, or of the President or Vice-Presidents.

They believe, however, that the Directors should, in order to carry out the instructions of the meeting in July last, indicate by what amendments of Bye-laws the suggested change may best be made, if the members think it desirable.

In this connection it must be pointed out that the Charter includes no reference to the Showyard Meeting.

If, therefore, the change be desired, it will be necessary either (1) to alter the Charter so as to constitute the Showyard Meeting a General Meeting of the Society; (2) to provide that the General Meeting, enacted to be held in June or July, be held in the Showyard in July; or (3) to make Bye-laws providing for the adjournment of this Meeting to the Showyard, in such a way as to defer the election of office-bearers to the adjourned Meeting in the Showyard.

The first course is, on obvious general grounds, undesirable, if it can be avoided.

The second course is open to the objection that the Showyard Meeting is not a very suitable occasion for deliberative purposes, since it must often take place at a remote centre, and be attended by an overwhelming predominance of the members residing in a particular Show Division.

The third course could be so adopted as to provide for the ordinary business of a General Meeting being transacted as heretofore in June, while reserving the election of all or any office-bearers for submission to the Showyard Meeting. The Showyard Meeting would thus be an adjourned General Meeting, and would come under the Bye-laws and rules of order regulating General Meetings.

In considering the situation, it should perhaps be borne in mind that the Showyard Meeting, as at present constituted, is held only at the option of the Directors, that it was originally intended merely as an occasion for discussion and suggestion, and that it has not the powers of a General Meeting as provided for in the Charter.

It is doubtful whether its decisions have any binding character, and whether it has power to alter Bye-laws or transact similar business. This view is presented in the following letter from the late President of the Society to the Chairman of the Board:—

EILDON HALL, ST BOSWELLS,
21st July 1914.

DEAR DOUGLAS,—I think the Directors of the Highland and Agricultural Society should consider the advisability of making Bye-laws, or, if that is not possible, rules to regulate the procedure at the Meeting in the Showyard.

At present there is no reference in the Bye-laws to the Showyard Meeting, and there is nothing to guide the Chairman in regard to procedure, and it appears to me that any motion can be made with or without notice; but, as the only recognised Meetings are the two statutory ones, it also appears to me that any motion that may

be carried at the Showyard Meeting is ineffective, the said Meeting having no power to alter any Bye-law, &c. However, I may be wrong; but under present circumstances it is exceedingly awkward for the Chairman of the Meeting if he is asked to decide upon a point of order or procedure when there are no rules for the conduct of the Meeting. Of course this does not apply to the point of order which was raised last Wednesday, because, in my opinion, in that case the proposal was contrary to the Charter and therefore out of order.—Yours sincerely,

(Signed) DALKEITH.

In order to be consistent with existing conditions, the Committee believe that a decision to make the change in question should, if arrived at, be made effective by enacting a new Bye-law as follows:—

“The General Meeting appointed to be held in June or July shall be held on a day not later than the opening day of the Society's Show, and shall, if held before that day, be adjourned to be concluded in the Showyard on one of the days of the Show. Any business may, at the discretion of the Meeting, be postponed for consideration at the Adjourned Meeting; and the election of Extraordinary Directors shall be so postponed. Provided that no motion shall be voted on at the Adjourned Meeting, of which competent notice has not been given for the Meeting as originally called. Provided further, that in the event of the Society's Show not being held, the Adjourned Meeting shall be held on such day as may be determined by the Directors.”

It would further be desirable to prescribe definitely the form which must be taken by any amendment to the nominations proposed, by a Bye-law as follows:—

“No amendment on the nominations of Office-bearers shall be competent except the substitution of another name of a member willing to accept election for that of one of the nominees.”

It will be remembered that the occasion of the resolution passed was the dissatisfaction felt in certain quarters with the exercise of the Board's powers in recommending Extraordinary Directors.

The Hawick Showyard Meeting decisively rejected the proposal that retiring Ordinary Directors should be ineligible as Extraordinary Directors.

It is felt, however, by a certain number of members, that the powers of the Board should not be so exercised as to perpetuate the presence on the Board of Directors who, for a long period, have not sought election as Ordinary Directors; and the existence of a controversy on this subject is not in the interests of the Society.

The circumstances which led to the practice objected to have been in some degree modified by the fact that opportunities for ordinary election are now regularly afforded by the Bye-law which renders retiring Ordinary Directors ineligible for ordinary election till an interval of time has elapsed.

The Committee therefore suggest that the Board should recommend the following Bye-law for adoption:—

“The Board shall not recommend a Director for extraordinary election for more than two years in succession.”

The Committee further suggest that the words “Show Division” should be substituted for “Show District” wherever these words occur in the Bye-laws.

In order to remove all doubt as to the powers of the Showyard Meeting, as at present held, the Committee thought it desirable to consult the Society's Law Agents (Messrs Tods, Murray, & Jamieson, W.S.) on this point. The Law Agents express a definite opinion that, as the Showyard Meeting is not a General Meeting of the Society as stipulated by the Charters, it is not competent to deal at that Meeting with any business such as the election of Office-bearers, which is reserved by the Charters for the consideration and decision of one or other of the two Annual General Meetings.

7th April 1915.

Veterinary Inspection of Horses.

It was reported that the Committee on the Veterinary Examination of Horses had met that day and had formulated draft regulations for the inspection of Stallions at the forthcoming Show. In view of the decision not to proceed with the Show, it was agreed that further consideration of these regulations be postponed meantime,

Conference on Compensation for Improvements under Agricultural Holdings Act, 1908.

A letter was read from the Board of Agriculture for Scotland inviting the Society to appoint representatives to a Conference for the purpose of considering whether any, and if so what, steps should be taken to prepare a standard scale of compensation for improvements under the Agricultural Holdings (Scotland) Act, 1908.

The following delegates were appointed: The Chairman; Dr David Wilson of Carbeth; Mr James Inglis Davidson, Saughton Mains; Mr Thomas Elder, Stevenson Mains; Dr R. Shirra Gibb, Boon, Lauder; Mr Peter M'Intyre, Tighnablaair, Comrie.

General Meeting.

The Half-Yearly General Meeting of the Society was fixed to be held on Wednesday, 2nd June.

Blackface Wool.

The SECRETARY submitted a letter received from the Board of Agriculture for Scotland transmitting copy of a letter addressed to the Under-Secretary for Scotland by the Board of Trade, intimating revised arrangements in connection with the exportation of Blackface wool.

MEETING OF DIRECTORS, 5TH MAY 1915.

Mr CHARLES DOUGLAS, D.Sc., of Auchlochan, in the Chair.

Present.—*Vice-President*—The Earl of Haddington. *Ordinary Directors*—Mr John M'Hutchen Dobbie; Mr Charles Douglas, D.Sc.; Sir Archd. Buchan Hepburn, Bart.; Mr Hugh M. Leadbetter; Mr James M'Queen; Mr George Bertram Shields; Sir Hugh Shaw Stewart, Bart.; Mr R. D. Thom; Mr R. C. Young. *Extraordinary Directors*—Mr James Allison; Mr A. H. Anderson; Mr James I. Davidson; Mr John Edmond; Mr David Ferrie; Dr R. Shirra Gibb; Right Hon. Lord Provost Inches; Mr J. T. M'Laren; Mr William T. Malcolm; Mr John M. Martin; Mr James Wylie. *Treasurer*—Mr David Wilson, D.Sc. *Hon. Secretary*—Mr Alexander Cross. *Engineer*—Professor Stanfield. *Auditor*—Mr Wm. Home Cook, C.A.

Edinburgh Show, 1915.

Report to Half-Yearly General Meeting.—The Secretary read the following Draft Report by the Directors regarding the postponement of the Edinburgh Show, which it was proposed to submit to the Half-Yearly General Meeting of the Society on 2nd June. (See Proceedings at General Meeting, p. 327.)

Sir ARCHIBALD BUCHAN HEPBURN of Smeaton, Bart., formally moved approval of the Report.

Mr M'HUTCHEN DOBBIE seconded.

The CHAIRMAN explained why it happened that it was only at this stage, a month after the Board's decision, that their reasons for abandoning the Show of 1915 were communicated to the public. It was quite evident that at last Meeting it would be idle to proceed with the business of arranging details for the Edinburgh Show until the previous question had been decided as to whether the Show should take place or not, and therefore it fell to him to decide whether they should go into Committee or not. Two considerations presented themselves. If the Show was to be postponed, there was much to be said for allowing members of the Society and the public to know the Board's view as soon as might be. On the other hand, there was also the possibility that the Board might decide to maintain its decision to hold the Show, and if that had been the decision of the Board, then every member of the Society would recognise that it would have been a great disadvantage to have had speeches made which would have contributed to the non-success of the Show.

The Report was unanimously approved.

Arrangements as to Field, &c.—The Secretary reported that satisfactory arrangements had been made with Messrs Speedie Brothers regarding the Show Field. They

had agreed to take over the full tenancy for the current year, and were prepared to enter into a similar arrangement when the Show was held in Edinburgh. The Caledonian Railway Company had agreed to this, and to the other arrangements regarding the field and accesses thereto holding good for a future occasion. Contracts with caterers, hotel, &c., had been cancelled, and all implement exhibitors at the Shows of past three years had been notified.

Donation by City of Edinburgh.—A letter was submitted from the Town Clerk of Edinburgh in which it was stated that the grant of 400 guineas towards the expenses of the Edinburgh Show of 1915 now lapsed, and that it would be necessary for the Society to make a formal application for a grant when the Show was to be held in Edinburgh.

LORD PROVOST INCHES said he was quite sure that the Magistrates and Town Council would give the same grant when the Show came to Edinburgh.

The CHAIRMAN expressed the gratification of the Board at receiving this assurance from the Lord Provost of Edinburgh.

Requisition by Members.—The Secretary read a Requisition, dated 14th April, signed by forty-one members, to call a Special Meeting of the members of the Society in order to reconsider the decision of the Directors in cancelling the 1915 Show at Edinburgh. He said that on receiving the requisition he had written to the member whose signature appeared first on the list, pointing out that, as Secretary, he had no power to call a General Meeting of members. That could only be done, according to the Charters of the Society, by the Board of Directors.

The CHAIRMAN said there was no rule, according to the Charter, by which on a certain requisition a Special General Meeting must be called. The responsibility for calling such a Meeting rested entirely with the Directors. So far as effecting any practical purpose was concerned, no Meeting could be held in time to enable arrangements to be made for holding the Show this year. It was a question whether the Directors should call a Special Meeting when the Half-Yearly Meeting was so near at hand. It would be held only about a fortnight after the earliest possible date at which a Special Meeting could be held. If no one moved that such a Meeting be held, it would not take place. The matter lay with the Board.

There was no proposal to the effect that a Special Meeting be held. The Secretary was accordingly instructed to write to the petitioners pointing out the general considerations above mentioned.

Arrangements for Future Shows.

Sir ARCHIBALD BUCHAN HEPBURN moved that the next Show of the Society be held at Edinburgh, and that the subsequent Shows be held in Aberdeen and Stirling according to the ordinary rotation.

Mr J. INGLIS DAVIDSON seconded, and the motion was unanimously agreed to.

Aberdeen Show.

A letter was submitted from the Town Clerk of Aberdeen stating that, while recognising the force of the considerations urged by the Directors, the Council did not see their way to increase their donation to the funds of the Show to more than the sum originally voted (£100).

Vacancy on the Board.

On the recommendation of the Ordinary Directors in the Perth district, it was unanimously agreed to nominate Mr Hugh Martin, Flowerdale, Kinrossie, to fill the vacancy on the Board caused by the death of Mr W. S. Ferguson.

National Diploma in Agriculture.

Mr ALEXANDER CROSS of Knockdon, Convener of the Education Committee, submitted a Report on the results of the recent examination at Leeds for the National Diploma in Agriculture.

MEETING OF DIRECTORS, 2ND JUNE 1915.

Mr CHARLES DOUGLAS, D.Sc., of Auchlochan, in the Chair.

Present.—Ordinary Directors—Mr Walter Biggar; Mr George W. Constable; Mr John M'Hutchen Dobbie; Mr Charles Douglas, D.Sc.; Sir Archd. Buchan Hepburn, Bart.; Mr Hugh M. Leadbetter; Mr William MacDonald; Mr Peter MacIntyre; Mr George Bertram Shields; Sir Hugh Shaw Stewart, Bart.; Mr Duncan Stewart; Mr D. A. Stewart; Mr R. D. Thom; Mr R. C. Young. *Extraordinary Directors*—Mr James Allison; Mr A. H. Anderson; Mr James I. Davidson; Mr Thomas Elder; Mr David Ferrie; Dr R. Shirra Gibb; Mr J. T. M'Laren; Mr William T. Malcolm; Mr John M. Martin; Mr Archibald Whyte. *Treasurer*—Mr David Wilson, D.Sc. *Hon. Secretary*—Mr Alexander Cross. *Engineer*—Professor Stanfield. *Chemist*—Mr J. F. Tocher, D.Sc.

Edinburgh, Aberdeen, and Stirling Shows.

A draft report by the Board of Directors to the Half-Yearly General Meeting of Members regarding the future arrangements for the Society's Annual Shows was submitted and approved. (See Proceeding at General Meeting, page 329.)

Aberdeen Show.

A letter was submitted from the Town Clerk of Aberdeen stating that the donation of £100 voted by the Council in connection with the intended Show at Aberdeen in 1916 would remain good for the postponed Show. The letter also gave, in detail, the conditions under which the Council had agreed to grant the use of the Links as a site, and a supply of water, free of charge.

Edinburgh Agricultural Association.

A letter from the Secretary of the Edinburgh Agricultural Association, dated 13th May 1915, was read, applying for a grant in aid of the funds of the Association's Show, to be held in Edinburgh this year.

Dr WILSON stated that the Finance Committee had considered the letter, and had unanimously decided to recommend that a grant of £100 be given. He moved accordingly.

Mr M'HUTCHEN DOBBIE seconded, and the grant was agreed to.

Implement Trials.

A Minute of Meeting of the Implement Trials Committee, dated 2nd June, was submitted.

The Minute recommended that the Committee be given powers to arrange for an Exhibition Trial of Motor Implements, provided it was found practicable to organise such a demonstration, and that they be authorised to incur expenses not exceeding £300 in connection therewith.

Mr J. T. M'LAREN, Convener, in moving approval of the Minute, said the Committee were strongly of opinion that the trial should be held, if found at all possible. In view of the great scarcity of farm labour at the present time, it was only right that the Agricultural community should have an opportunity of seeing in operation implements that might reduce labour on the farm.

Mr R. C. YOUNG seconded, and the Minute was approved.

Publications.

On the recommendation of the Publications Committee, payments to writers of articles in the 'Transactions,' amounting to £186, 17s., and outlays connected therewith, £14, 8s. 6d., were authorised.

Motions for General Meeting.

The following motions, to be moved at the Half-Yearly General Meeting, were duly notified to the Board of Directors for the second time, in terms of the Charter:—

1. "That the following Bye-law be adopted—'The Board shall not recommend a Director for extraordinary election for more than two years in succession.'"
2. "That when the Bye-laws are reprinted the words 'Show Division' be substituted for 'Show District' wherever these words occur."

Milk and Dairies' (Scotland) Act.

Letters from the Secretary of the National Farmers' Union of Scotland, dated 21st and 22nd May 1915, were read, asking the Society to use its influence in securing the postponement of the date of coming into effect of the Milk and Dairies' Act and the Tuberculosis Order.

The CHAIRMAN stated that the Conference which was created by the Board to consider the Milk and Dairies' Bill was still in being, and acting on behalf of the Board, as Convener of that Conference, he had had it in view to summon a further meeting. The Conference represented all the interests involved very fully. He suggested that the Farmers' Union, which had interested itself in the question of milk supply, should be invited to send two delegates. The date for which he proposed to call the Conference was June 16th.

The CHAIRMAN'S proposal was agreed to.

(At this stage the Board sat in Committee.)

Finance.

A Minute of Meeting of Committee, dated 2nd June, was submitted and approved. The Minute recommended (1) that a grant of £100 be given from the St Kilda Fund towards the relief of the present distress on the island; (2) that a special grant of £100 be given to the Edinburgh Agricultural Association towards the expenses of the Association's Show to be held in Edinburgh this year; (3) that steps be taken to amend Bye-law No. 2, which defines the classes of candidates who shall be admitted at the lower rate of subscription, so as to include "such other persons as, in respect of their official or other connection with Agriculture, the Board of Directors may consider eligible."

**SPECIAL MEETING OF DIRECTORS HELD IN THE EDINBURGH
AGRICULTURAL ASSOCIATION'S SHOWYARD, SAUGHTON PARK,
14TH JULY 1915.**

Mr ALEXANDER CROSS of Knockdon in the Chair.

Present.—*Ordinary Directors*—Mr Walter Biggar; Mr John M'Hutchen Dobbie; Mr Hugh M. Leadbetter; Mr James M'Laren; Mr John C. Robertson; Mr Hugh Martin. *Extraordinary Directors*—Mr James Allison; Mr A. H. Anderson; Mr James I. Davidson; Mr John Edmond; Mr David Ferrie; Dr R. Shirra Gibb; Mr James A. Hunter; Mr J. Ernest Kerr; Mr W. T. Malcolm; Mr J. T. M'Laren; Mr John M. Martin; Mr James Wylie. *Hon. Secretary*—Mr Alexander Cross.

Finance.

The Secretary explained that with the issue of the new 4½ per cent War Loan, the question had arisen of transferring or converting into War Stock the Society's holding of Consols. After consultation with the Chairman of Directors and the Convener of the Finance Committee, a circular letter was sent, on 2nd July, to each member of the Board proposing that steps be taken to transfer the Society's holding of Consols, amounting to £5900, into the new War Loan, and also to invest therein a further sum of £2700 then on Deposit Receipt and Current Account.

In order to avoid the necessity of calling a Special Meeting of the Board, any Director who objected to the course proposed was asked to intimate his objection not later than 5th July. No objection was received.

Arrangements had therefore been made for the sale of £2620 Consols, from which a sum of £1700 would be realised. This, with the £2700 in bank above referred to, would enable the Society to invest £4400 in cash in War Stock. Conversion rights would also thus be acquired to convert the remainder of the Society's holding of Consols, amounting to £3280, into War Stock, at the rate of £75 Consols for £50 War Loan, giving £2186, 13s. 4d. War Stock. The Society's total holding in War Stock would therefore be £6586, 13s. 4d.

The Special Meeting of the Board had been called to authorise the signature, in terms of the Charter, of the Letter of Attorney for the sale of £2620 Consols.

The requisite authority having been given, the Letter of Attorney was duly signed by three Ordinary Directors and by the Honorary Secretary.

Implement Trials.

A Minute of Meeting of Committee, dated 14th July, was submitted and approved.

The Minute reported that as a result of correspondence with makers of Motor Implements, it had been decided to proceed with the Trial. Various offers of fields for the Trial had been received, and a Sub-Committee had been appointed to select a suitable site where both carse and dryfield land would be available.

SPECIAL MEETING OF DIRECTORS, 15TH SEPTEMBER 1915.

Mr CHARLES DOUGLAS, D.Sc., of Auchlochan, in the Chair.

Present.—*Vice-President*—The Earl of Haddington. *Ordinary Directors*—Mr George W. Constable; Mr John M'Hutchen Dobbie; Mr Charles Douglas, D.Sc.; Mr William MacDonald; Mr Hugh Martin; Mr John C. Robertson; Mr G. Bertram Shields; Mr Duncan Stewart; Mr R. C. Young. *Extraordinary Directors*—Mr Thomas Elder; Mr David Ferrie; Dr R. Shirra Gibb; Mr J. T. M'Laren; Mr William T. Malcolm; Mr Archibald Whyte; Mr James Wylie. *Auditor*—Mr Wm. Home Cook, C.A.

Finance.

The CHAIRMAN explained that the special business for which the Meeting had been called was to authorise the signature, in terms of the Charter, of the Form of Application for Conversion of £3280 Consolidated Stock into War Stock. He moved that the necessary authority be given.

Mr J. T. M'LAREN seconded, and the motion being unanimously agreed to, the Form of Application was duly signed by three ordinary members and by the Secretary.

Implement Trials.

The Minutes of Meetings of Sub-Committee, dated 13th August, and of Committee, dated 15th September, were submitted.

The Minutes stated that the Trial would take place at King's Park Farm, Stirling, on 5th and 6th October, and reported the appointment of official observers, and other details of the arrangements.

A letter was submitted from Mr F. J. Baxter, Interim Secretary of the Inverness-shire Farmers' Society, dated 23rd August, containing a request from a large and representative meeting of Secretaries and Delegates from all the Societies embraced in the Northern District of the Highland and Agricultural Society, that the Society should repeat, somewhere in the North, the demonstration which they understood was to be held at Stirling.

In accordance with a recommendation of the Implement Trials Committee, it was agreed, on the motion of Mr J. T. M'LAREN, seconded by Mr W. T. MALCOLM, that the request be granted—this Society to bear the cost of carriage, and endeavour to induce manufacturers to send machines north; the Local Committee to carry out all the local arrangements and bear the local expenses. An additional grant of £100 was also voted to cover the expenses.

MEETING OF DIRECTORS, 3RD NOVEMBER 1915.

Mr CHARLES DOUGLAS, D.Sc., of Auchlochan, in the Chair.

Present.—*Ordinary Directors*—Mr George Bean; Mr William Carrick; Mr George W. Constable; Mr John M'Hutchen Dobbie; Mr William Elliot; Mr Hugh M. Leadbetter; Mr Murray Little; Mr William MacDonald; Mr Peter MacIntyre; Mr Robert Macmillan; Mr Hugh Martin; Mr William Mungall; Mr George Bertram Shields; Mr John P. Sleight; Sir Hugh Shaw Stewart, Bart.; Mr Duncan Stewart; Mr D. A. Stewart; Mr R. D. Thom. *Extraordinary Directors*—Mr James Allison; Mr James I. Davidson; Mr Charles Douglas, D.Sc.; Mr Thomas Elder; Mr David Ferrie; Sir Archd. Buchan Hepburn, Bart.; Mr R. Macdiarmid; Mr J. T. M'Laren; Mr John M. Martin; Mr William Poole. *Treasurer*—Mr David Wilson, D.Sc. *Honorary Secretary*—Mr Alexander Cross. *Engineer*—Professor Stanfield. *Chemist*—Mr J. F. Tocher, D.Sc.

The late Lord Ninian Crichton-Stuart, M.P.

Before proceeding with the business of the Meeting, the CHAIRMAN referred in sympathetic terms to the death in action of Lord Ninian Crichton-Stuart, M.P. He said they would all recall the remarkable enthusiasm with which his Lordship had discharged the duties of President of the Society in the year 1912. They had formed the highest expectations as to his future services in the cause of Agriculture, and they deeply regretted the sad termination to a promising career. He submitted the terms of a resolution to be engrossed in the Minutes, expressing the Board's appreciation of his Lordship's valuable services to the Society, their deep regret at his untimely death, and their sincere sympathy with Lady Ninian Crichton-Stuart and her family in their sad bereavement.

The late James Wylie.

The CHAIRMAN also referred to the death of Mr James Wylie, who, although identified chiefly with another agricultural society, had been for many years an Assistant-Steward of Horses, and for the current year was an Extraordinary Director. He moved approval of a resolution expressing the Directors' appreciation of the valuable services rendered by Mr Wylie to the Society, the deep regret with which they had received the intimation of his death, and their sincere sympathy with Mrs Wylie and the family of the deceased.

These resolutions were unanimously adopted, the members present upstanding, and the Secretary was instructed to send extracts of the respective resolutions to Lady Ninian Crichton-Stuart and to Mrs Wylie.

Chairman of the Board for 1915-1916.

Sir ARCHIBALD BUCHAN HEPBURN of Smeaton, Bart., moved that Mr Charles Douglas, D.Sc., of Auchlochan, be re-elected Chairman of the Board for another year. In making this proposal, he said they were departing from precedent, as hitherto the Chairman had held office for two years only. The times, however, were abnormal, and it was the unanimous feeling of the Board in Committee that it was in the interests of the Society that their present Chairman should continue in office for another year.

Mr ALEXANDER CROSS of Knockdon seconded, and the motion was unanimously carried.

Mr Douglas, in agreeing to accept office, thanked the Directors for the honour they had done him.

Standing Committees.

It was intimated that the Standing Committees for the ensuing year had been appointed by the Board in Committee, and the names would be printed as usual in the Premium Book.

Representatives on other Bodies.

The following were appointed representatives of the Society on the Boards of Management of the undernoted institutions for the ensuing year—viz.: *West of Scotland Agricultural College*—Sir Hugh Shaw Stewart, Bart., of Ardgowan and

Blackhall, Ardgowan, Greenock; John M. Martin, Scottish Conservative Club, Edinburgh. *Edinburgh and East of Scotland College of Agriculture*—David Ferrie, Parbroath, Cupar-Fife; Sir Archibald Buchan Hepburn of Smeaton, Bart., Prestonkirk. *Aberdeen and North of Scotland College of Agriculture*—Dr J. F. Tocher, 41½ Union Street, Aberdeen; William Duthie, Tarves. *Royal (Dick) Veterinary College*—John M. Martin, Scottish Conservative Club, Edinburgh. *Glasgow Veterinary College*—Alexander Cross of Knockdon, 19 Hope Street, Glasgow. *Scottish Milk Records Association*—Alexander Cross of Knockdon; John M'Caig of Belmont; Sir Hugh Shaw Stewart, Bart., of Greenock and Blackhall.

Letters.

The Secretary submitted the following letters:—

1. From Dr R. Shirra Gibb, dated 30th October, resigning his position as a representative of the Society on the Board of Governors of the Edinburgh and East of Scotland College of Agriculture.

2. From Major W. T. R. Houldsworth, dated 19th September, stating that as he was now under orders to proceed on active service, he would be unable to attend the Meetings of the Board in the meantime.

The Chairman explained that Major Houldsworth had asked him if he should resign from the Board, and he had assured him that the Directors would not desire that any member should resign on account of his being engaged in active military service.

3. From Mr A. M'Kinnon, Missionary at St Kilda, thanking the Board for the grant of £100 from the St Kilda Fund to provide supplies for the inhabitants during the coming winter.

4. From the Secretary of the Highland Reel and Strathspey Society, thanking the Directors for the use of the Society's Hall for their weekly practice.

Annual Show.

The CHAIRMAN said it was usual at that Meeting to receive a report by the Shows Committee. It had been considered advisable, however, this year not to call a Meeting of the Committee, on two grounds. In the first place, the arrangements for the next Edinburgh Show had been very largely made in advance, in respect of the Show which it had been intended to hold this year, and therefore there was no urgency. In the second place, all the circumstances pointed to the necessity for very careful consideration before any decision was come to regarding the holding of a Show in 1916. He suggested that it be remitted to the Shows Committee, as its first duty, to consider and report on that question. This was unanimously agreed to.

Milk and Dairies' (Scotland) Act.

The Report of the proceedings at the Conference on the above Act, held on 16th June, was laid on the table.

The CHAIRMAN stated that, as the members of the Board were aware, the coming into operation of the Act had been postponed to a period considerably after the termination of the war.

National Diploma in Dairying.

Mr ALEXANDER CROSS, Convener of the Education Committee, submitted Reports on the Examinations for the National Diploma in Dairying, held at Reading and Kilmarnock in the end of September, showing that 23 candidates presented themselves at Reading, of whom 15 passed, and 28 at Kilmarnock, of whom 22 passed.

Motor Implement Trials.

A Minute of Meeting of Committee, which was accompanied by the official Report on the Exhibition Trial of Motor Implements, held at Stirling on 5th and 6th October, was submitted.

Mr J. T. M'LAREN, Convener, in moving approval of the Minute and of the Report, dealt at length with various points in connection with the Trial. While the implements did well up to a certain point, he was of opinion that the perfect motor tillage implement had not yet been put on the market. The great interest taken in the demonstration, however, proved that farmers were quite prepared to consider the

purchase of these implements when a suitable one was produced. The total cost of the Trial was well within the amount sanctioned by the Directors.

The Minute and Report were approved, and it was agreed that the latter be published forthwith. (See pages 281 to 296.)

On the motion of Mr M'LAREN, cordial votes of thanks were accorded to the following gentlemen for their services in connection with the Trial:—

The Messrs Dewar, King's Park Farm, who placed their fields at the disposal of the Society.

Messrs John Edmond of Gallamuir; James Kidd, Mains of Errol; and James Walls, Muirton, Stirling, the Official Observers.

Messrs W. T. Malcolm, Dunmore; A. H. Anderson, Kippendavie Estates Office; and James M'Laren, Alton, the Local Sub-Committee.

Mr R. D. Cox, Road Surveyor for the Central District of Stirlingshire, for assistance in connection with the road haulage tests; and

Captain Kemp Smith for securing ploughs for use with the tractors.

Demonstration at Allanfearn.

Mr M'LAREN further reported that a Demonstration of Motor Ploughing had been held on Allanfearn Farm, Inverness, on 16th October. The Trial was held under the patronage of the Society, but the arrangements had been made by a Local Committee representing the Local Agricultural Societies in the North. The Trial was well attended by farmers from a wide area, and much of the work done was of a high standard.

A vote of thanks was accorded to Mr W. A. Cumming, Allanfearn Farm, for providing a site for the Demonstration.

On the motion of the CHAIRMAN, Mr J. T. M'Laren and the Implement Trials Committee were cordially thanked for their admirable services in connection with these Trials.

Report by Chemist on Deficient Samples.

The Society's Chemist submitted a Report on deficient samples of manures and feeding-stuffs analysed by him for members since the Meeting of the Board in June.

MEETING OF DIRECTORS, 1ST DECEMBER 1915.

Mr CHARLES DOUGLAS, D.Sc., of Auchlochan, in the Chair.

Present.—Ordinary Directors—Mr George Bean; Mr William Carrick; Mr George W. Constable; Mr John M'Hutchen Dobbie; Mr James Elder; Mr William Elliot; Mr Hugh M. Leadbetter; Mr Murray Little; Mr William MacDonald; Mr Peter MacIntyre; Mr Hugh Martin; Mr William Mungall; Mr John P. Sleigh; Sir Hugh Shaw Stewart, Bart.; Mr D. A. Stewart; Mr R. C. Young. *Extraordinary Directors*—Mr James Allison; Mr Charles Douglas, D.Sc.; Mr David Ferrie; Mr R. Macdiarmid; Mr J. T. M'Laren; Mr John M. Martin; Mr William Poole; Mr John C. Robertson. *Hon. Secretary*—Mr Alexander Cross. *Chemist*—Mr J. F. Tocher, D.Sc.

Trial of Motor Implements.

A letter was submitted from Messrs Mills & Sons, Ltd., London, who exhibited a "Sandusky" tractor and plough at the recent demonstrations at Stirling and Inverness, enclosing a cheque for £20, which they desired to give as a donation to the Society's Funds.

The donation was accepted, and the Secretary was instructed to convey the cordial thanks of the Board to Messrs Mills & Sons.

Vacancy on Board.

On the motion of Mr M'HUTCHEN DOBBIE, it was unanimously agreed to recommend to the General Meeting in January that Mr Harry Hope, M.P., be appointed to fill the vacancy on the Board caused through the death of the late Mr James Wylie.

Annual Show.

A Minute of Meeting of Shows Committee, dated 30th November, was submitted and unanimously approved.

The Minute recommended that in the present circumstances no steps should be taken towards holding a Show next year.

Proposed Alteration of Bye-laws.

The following proposed alteration of Bye-law No. 2, agreed to at the Meeting of Directors on 2nd June, was formally notified to the Board in terms of the Charter—viz., the addition of the following words after the words "Veterinary Surgeons" in line 6, "and such other persons as, in respect of their official or other connection with Agriculture, the Board of Directors may consider eligible."

Supply of Artificial Manures.

A communication was read from the Board of Agriculture for Scotland, dated 22nd November, referring to the circular letter issued by them in December 1914 recommending farmers to obtain their supplies of artificial manures at an early date, and, if possible, not later than January or February. The difficulties arising from shortage of labour in the factories, and from delay in transport, were much greater than they were last year. Supplies should be obtained as early as possible, otherwise farmers might find it impossible to secure these in time for the crops of the season. The matter was the more urgent on account of the intention of many farmers to use increased quantities of artificial manures during the coming spring.

Mr R. C. YOUNG drew attention to the Circular issued by the Board of Agriculture and Fisheries regarding the purchase, at a fixed price, of sulphate of ammonia, to be applied during the months of November and December. He wished the Directors to ask the Board of Agriculture to extend the time until the end of March. It was impracticable to apply sulphate of ammonia to crops in Scotland during November or December.

Mr ALEXANDER CROSS referred to the transport difficulties, and suggested that attention should be called to the scarcity of trucks.

After further discussion it was agreed that the Secretary be instructed, in replying to the above communication, to request the Board of Agriculture for Scotland to urge upon the Board of Agriculture and Fisheries and the Fertilisers Committee the importance of the foregoing considerations. On the suggestion of Mr M'HUTCHEN DOBBIE, it was also agreed to incorporate a representation that the arrangement as to a fixed price should be extended so as to embrace the qualities of sulphate of ammonia manufactured in Scotland.

Heather Burning.

A letter from the Board of Agriculture for Scotland with regard to the burning of heather was read.

Sir HUGH SHAW STEWART, Bart., said that from his own experience he could testify that it was much to the interest of the owner himself that he should burn the heather as regularly and as extensively as was reasonably possible. By that means he not only improved the stock of grouse but he also improved the pasture for the sheep. There was no opposition between the two interests. What caused difficulty sometimes was that tenants wanted to burn without notifying the gamekeepers. Mutual agreement between tenant-farmers and gamekeepers would lead to the benefit both of the farmer and the proprietor. In the west it was sometimes impossible, on account of the weather, to get burning done within the time permitted, but in a dry season they could burn as much as possible.

Mr PETER MACINTYRE pointed out that, by mutual agreement between both parties, the Sheriff could extend the period for burning to 21st April. The burning necessarily depended a good deal on the nature of the land. On some lands the heather grew much more rapidly than on others. He did not think there was need for legislation to extend the period for burning, if suitable weather could be got; and he emphasised the necessity for taking advantage of a dry season to make up leeway arising from a bad season.

It was agreed to write to the Board of Agriculture in reply communicating th views expressed as above.

District Shows.

A Report by the Shows Committee, dated 30th November, relating to District Competitions, was read and approved.

The Committee recommended nineteen districts for grants of £12 each; fourteen districts for three Silver Medals each; eleven districts for grants of £15 each for Stallions; special grants of £40 for Highland Home Industries; £20 to Kilmarnock Cheese Show; two Medals to Ross-shire Crofters' Club; £5 to Shetland Agricultural Society; £3 each to Unst, Orkney, Sanday, and North Uist; a Gold Medal and a Silver Medal to the British Dairymaids' Association; fifteen districts for two Medals each: the usual Medals at Ploughing Competitions; three Medals for Hoeing Competitions; and six districts for two Medals each for Cottages and Gardens; Long Service Medals and Certificates, say £50—making the total sum offered in 1916 £690, against £415, 10s. 7d. awarded in 1915.

Royal (Dick) Veterinary College.

A letter from Professor Rankine, Chairman of the Board of Management of the Royal (Dick) Veterinary College, asking for a further grant towards the Building Fund of the College, was read.

The CHAIRMAN said the letter had been considered by the Finance Committee that morning, but for various reasons the Committee was not yet in a position to make any recommendation to the Board. He suggested that the letter be remitted back to the Finance Committee for further consideration and report; and this was agreed to.

A letter from Mr C. E. Price, M.P., in support of the application, was also read.

Argyll Naval Fund.

A Minute of Meeting of Committee, dated 1st December, was read and approved.

The Minute recommended that two appointments be made to the list of beneficiaries—viz., Thomas Ian Scott Bell and Rowland Etienne Sinclair Hugonin.

MEETING OF DIRECTORS, 12TH JANUARY 1916.

Mr CHARLES DOUGLAS, D.Sc., of Auchlochan, in the Chair.

Present.—President—The Earl of Rosebery, K.G., K.T. *Ordinary Directors*—Mr Walter Biggar; Mr William Carrick; Mr George W. Constable; Mr John M'Hutchen Dobbie; Mr William Elliot; Mr Murray Little; Mr William MacDonald; Mr Peter MacIntyre; Mr Robert Macmillan; Mr James M'Queen; Mr Hugh Martin; Mr William Mungall; Mr G. Bertram Shields; Mr John P. Sleigh; Mr Duncan Stewart; Mr D. A. Stewart; Mr R. D. Thom. *Extraordinary Directors*—Mr James Allison; Mr James I. Davidson; Mr Charles Douglas, D.Sc.; Mr Thomas Elder; Mr David Ferrie; Sir Archibald Buchan Hepburn, Bart.; Mr J. Ernest Kerr; Mr R. Macdiarmid; Mr J. T. M'Laren; Mr William Poole; Mr John C. Robertson. *Honorary Secretary*—Mr Alexander Cross. *Treasurer*—Mr David Wilson, D.Sc. *Auditor*—Mr William Home Cook, C.A. *Chemist*—Mr J. F. Tocher, D.Sc. *Engineer*—Professor Stanfield.

The late Mr Scott Dudgeon.

Before proceeding with the business of the Meeting, the CHAIRMAN referred to the death of Mr John Scott Dudgeon, at one time a Vice-President, and for many years a Director of the Society, and moved that a resolution be engrossed in the Minutes expressing the deep regret with which the Directors received the intimation of his death, and their sense of the valuable services rendered by him to the Society.

The resolution was unanimously adopted, the members present upstanding, and the Secretary was instructed to send an extract thereof to Mrs Scott Dudgeon.

Letters.

The Secretary submitted the following letters :—

1. From Mr Harry Hope, M.P., thanking the Directors for nominating him as an Extraordinary Director, and agreeing to accept office.
2. From the Wester Ross Farmers' Club, thanking the Society for carrying through the Demonstration of Motor Tillage Implements at Allanfeearn on 16th October 1915, and for defraying the cost thereof.
3. From the Shorthorn Society, the Aberdeen-Angus Cattle Society, and the Ayrshire Herd-book Society, offering to contribute the usual prizes in the event of a Show being held this year.

Supply of Fertilisers.

The Secretary read letters from the Board of Agriculture for Scotland, dated 7th and 22nd December 1915, in reply to the representations by the Directors agreed upon at last Meeting.

On the question of extending, until the end of March, the period during which supplies of sulphate of ammonia could be obtained at the fixed rate, the Board of Agriculture enclosed a copy of a letter from the Fertilisers Committee, in which it was stated that the Committee was in active consultation with the Sulphate of Ammonia Association respecting the arrangements to be made with regard to spring supplies of sulphate of ammonia, and hoped it would be possible to make an announcement on the subject at an early date.

The Board also enclosed a copy of a letter from the Railway Executive Committee with regard to the carriage of fertilisers, in which it was stated that an instruction was being issued to the various Railway Companies asking them to take what steps were possible with a view to preventing any undue delay in the delivery of the traffic.

Mr GEORGE W. CONSTABLE drew attention to the large quantities of sulphate of ammonia being exported to neutral countries, including Holland, and asked whether something should not be done by the Directors towards the prevention of such export.

Mr THOMAS ELDER said that what was demanded by Scottish farmers was that they should get their supplies of sulphate of ammonia at a reasonable rate. Farmers in England had done so, for sowing in December, and the same privilege should be afforded to Scottish farmers for spring sowing.

After further discussion it was agreed to again bring these considerations under the notice of the Board of Agriculture for Scotland, and urge upon the Board the desirability of strong representations being made on the subject to the Fertilisers Committee.

Proposed Alteration of Bye-laws.

The following proposed alteration of Bye-law No. 2, agreed to at the Meeting of Directors on 2nd June 1915, was formally notified to the Board, for the second time, in terms of the Charter—viz., the addition of the following words after the words "Veterinary Surgeons" in line 6,—“and such other persons as, in respect of their official or other connection with Agriculture, the Board of Directors may consider eligible.”

Royal (Dick) Veterinary College.

A Minute of the Finance Committee regarding the application by the Royal (Dick) Veterinary College for a further grant towards the Building Fund of the College was submitted.

The Minute stated that the Committee did not see their way to recommend the Directors to make a further grant to the College at the present time.

Dr WILSON, in moving approval, said the Committee had been informed that the minimum sum absolutely necessary to put the College Buildings into a condition to receive students was £10,000. Of that sum £5000 might be received from Government, and £5000 would require to be raised locally. Every effort had been made to get subscriptions from private persons, and no further contributions were expected from that quarter. Unless, therefore, the Society was prepared to give £5000, which was out of the question, nothing they could give now would have the effect of enabling the buildings to be completed to such an extent that students could be accommodated.

The Report was unanimously approved.

Milking Machines, &c.

Mr WILLIAM POOLE submitted the following motion, which appeared under his name on the agenda :—

“That a Committee be appointed—(1) To consider in what way the Society may assist in increasing the use of Milking Machines by the farmers of Scotland. (2) To take into consideration the methods the Society should adopt to encourage the introduction of Agricultural Oil and Steam Power Machines best suited for the requirements of Scottish Farmers.”

In dealing with the first part of the motion, Mr Poole said he had been induced to bring forward the subject of Milking Machines after reading the article in the ‘Transactions’ showing the amount of work that had been accomplished by the Scottish Milk Records Committee. It appeared to him that there was an immense amount of valuable information there which might be useful in determining the extent to which milking machines might be further utilised in Scottish dairies. He understood that the difficulties encountered hitherto were not so much in connection with the machines themselves as with the persons who were responsible for their management. He thought that the Society might do something to encourage men to excel in taking charge of such machines by offering prizes, in the same way as was done for ploughing.

With regard to the second part of the motion, he said a large number of different types of oil tractors were being put before farmers in America, but the great difficulty arose in adapting these machines to the peculiar soil and weather conditions with which they had to contend in Scotland. Many improvements had been required on harvest implements before they were finally adapted for use in this country, and in the case of motor ploughs and tractors history was likely to repeat itself. The Directors should give their opinion as to what was desirable, with possibly also a price limit. Substantial premiums should be offered to agricultural engineers for the best machines produced.

The CHAIRMAN said the Directors had already attempted to do something in the directions indicated. He hoped that the forthcoming volume of ‘Transactions’ would contain an interesting and useful paper on petrol and oil machinery on the farm, and in the following year’s ‘Transactions’ an article on Milking Machines would appear, based on a very careful study of all types of machines now in use in Scotland.

He suggested that the motion be remitted to the Implement Trials Committee for consideration and report, and that Mr Poole be added to the Committee, and this was unanimously agreed to.

Long Service Certificates and Medals.

A Minute of Meeting of Shows Committee, dated 12th January, was read and approved.

The Minute recommended that the question of the design of the certificate and the size and design of the medal be remitted to the following Sub-Committee for consideration and report—Sir A. Buchan Hepburn, Mr William Elliot, the Chairman, and the Secretary.

MEETING OF DIRECTORS, 2ND FEBRUARY 1916.

Mr CHARLES DOUGLAS, D.Sc., of Auchlockan, in the Chair.

Present.—*Ordinary Directors*—Mr William Carrick; Mr George W. Constable; Mr John M’Hutchen Dobbie; Mr William Elliot; Mr William MacDonald; Mr Peter MacIntyre; Mr Robert Macmillan; Mr James M’Queen; Mr William Mungall; Mr G. Bertram Shields; Sir Hugh Shaw Stewart, Bart.; Mr Duncan Stewart; Mr R. D. Thom; Mr R. A. Young. *Extraordinary Directors*—Mr James Allison; Mr Charles Douglas, D.Sc.; Mr David Ferrie; Mr Harry Hope, M.P.; Mr J. Ernest Kerr; Mr J. T. M’Laren. *Hon. Secretary*—Mr Alexander Cross. *Treasurer*—Mr David Wilson, D.Sc. *Chemist*—Mr J. F. Tocher, D.Sc.

Letters.

The SECRETARY submitted the following letters:—

1. From Mr A. F. Giles, on behalf of Mrs Scott Dudgeon, thanking the Directors for the resolution of Condolence passed at last Meeting of the Board on the death of her husband, the late Mr John Scott Dudgeon.

2. From Mr William G. Walker, Secretary of the Carse of Gowrie and Dundee District Farmers' Club, enclosing copy of the following resolution passed at a Meeting of the Club on 18th January: "That the Club is of opinion that union among proprietors, farmers, and others interested in Agriculture is absolutely necessary in their interests, and that we resolve to take such steps as may be deemed necessary for this purpose."

The CHAIRMAN said it was open to any member of the Board to move in this matter, but no motion was made, and accordingly no action was taken.

Science.

A Minute of Meeting of Science Committee, dated 2nd February, was read and approved.

The Minute recommended that the Schedule of Unit Values of Manures and Feeding-stuffs be issued as usual, but that the various prices be taken from the Board of Agriculture's circular of that date, and that a note be added indicating the source of these values.

National Diploma in Agriculture.

Mr ALEXANDER CROSS of Knockdon, Convener of the Education Committee, reported that the dates of the examination for the National Diploma in Agriculture had been originally fixed for the period from the 17th to the 20th of April, but in order to allow certain candidates who had attested under Lord Derby's recruiting scheme to appear for the examination before being called up, it had been decided to alter the dates to the period from the 20th to the 24th of March.

The alteration of dates was approved.

Argyll Naval Fund.

A Minute of Meeting of Committee, dated 2nd February, was read and approved.

The Minute recommended the appointment of Ean Charles Colville Greenlees to a vacancy in the list of beneficiaries.

Milking Machines.

A Minute of Meeting of Implement Trials Committee, dated 2nd February, was read and approved.

The Minute reported that the Committee had decided to prepare a Schedule of Enquiries to be sent to all users of Milking Machines in Scotland, with the view of obtaining material for consideration by the Committee; and that it had been remitted to the following Sub-Committee to draft the Schedule and deal with the replies received—Mr J. T. M'Laren, *Convener*; Mr Charles Douglas, Dr David Wilson, Mr Alexander Cross, Mr William Poole, Mr John M'Caig, and the Secretary.

PROCEEDINGS AT GENERAL MEETINGS.

GENERAL MEETING, 2ND JUNE 1915.

MR JOHN M. MARTIN in the Chair.

New Members.

67 candidates were balloted for and admitted Members of the Society.

Vacancy on Board of Directors.

On the recommendation of the Board of Directors, Mr Hugh Martin, Flowerdale, Kinrossie, Perth, was elected an Ordinary Director for the Perth Show District for one year, in room of the late Mr W. S. Ferguson, Pictstonhill.

Election of Office-bearers.

The following noblemen and gentlemen were elected office-bearers of the Society for the year 1915-16:—

President—The Earl of Rosebery, K.G., K.T., Dalmeny Park, Edinburgh.

Vice-Presidents—The Earl of Haddington, Tynninghame, Prestonkirk; The Marquis of Linlithgow, Hopetoun House, South Queensferry; Colonel Wardlaw Ramsay of Whitehill, Rosewell; Major F. J. Carruthers of Dormont, Lockerbie.

Ordinary Directors—Mr Arthur B. Nicolson of Glenbervie, Fordoun; Mr Duncan Stewart of Millhills, Crief; Mr Robert MacMillan of Holm of Dalquhairn, Woodlea, Moniaive; Mr D. P. Henderson of Stemster, Halkirk, Caithness; Mr Hugh Martin, Flowerdale, Kinrossie, Perth; Mr Robert C. Young of Shoddesden, Netherfield, Johnstone; Mr Hugh M. Leadbetter, Knowesouth, Jedburgh; Mr John M'Hutchen Dobbie, Campend, Dalkeith; Mr Peter Macintyre, Tighnablaire, Comrie; Mr Walter Biggar, Grange Farm, Dalbeattie; Mr William Macdonald, Strowan, Annfield Road, Inverness; Mr William Steuart Fotheringham of Fotheringham and Murthly, Murthly; Sir Hugh Shaw Stewart, Bart., of Greenock and Blackhall, Ardgowan, Greenock; Lord Dunglass, Springhill, Coldstream; Sir Henry Dundas, Bart., Polton House, Lasswade; Mr George Bean, West Balloch, Montrose; Mr James M'Queen of Crofts, Dalbeattie; Mr D. A. Stewart, Lochdhu, Nairn; Mr R. D. Thom of Pitlochrie, Gate-side; Mr William Elliot, Lanark; Mr George W. Constable, Traquair Estate Office, Innerleithen; Mr G. Bertram Shields, Dolphingstone, Tranent; Mr A. F. Irvine of Drum, Drumoak; Colonel G. J. Fergusson-Buchanan of Auchentorlie, Bowling; Major W. T. R. Houldsworth, Kirkbride, Maybole; Mr William Mungall of Transy, Dunfermline; Mr William Carrick, the Baad, Stirling; Mr James Elder, Athelstaneford Mains, Drem; Mr John P. Sleigh, St John's Wells, Fyvie; Mr Murray Little, Solicitor, Annan; Mr P. B. MacIntyre, Findon Mains, Conon Bridge; Mr Samuel Strang Steel, of Philiphaugh, Selkirk.

Extraordinary Directors—Mr David Ferrie, Parbroath, Cupar-Fife; Mr J. Ernest Kerr of Harviestoun Castle, Dollar; Mr Archibald Whyte, Inverquhar, Kirriemuir; Mr Charles Douglas, D.Sc., of Auchlochan, Leamnahagow; Sir Archibald Buchan Hepburn of Smeaton, Bart., Prestonkirk; Mr Robert Macdiarmid, Corries, Lochawe; The Hon. A. D. Murray, Scones Lethendy, Perth; Mr William Poole, Englewood, Blackhall; Mr C. H. Scott Plummer of Sunderland Hall, Selkirk; Mr John C. Robertson, Fodderty, Dingwall; Right Honourable Lord Provost Inches, 2 Strathearn Road, Edinburgh; Brig-General R. Gordon Gilmour of Craigmillar, The Inch, Liberton; Mr James Allison, Clifton Mains, Ratho; Mr J. Stewart-Clark of Dundas Castle, South Queensferry; Mr J. Inglis Davidson, Saughton Mains, Corstorphine; Mr Thomas Elder, Stevenson Mains, Haddington; Mr J. T. M'Laren, The Leuchold, Dalmeny House, Edinburgh; Mr J. M. Martin, 111 Elgin Crescent, Nottingham, London, W.; Mr A. Agnew Ralston, Philipstoun House, Philipstoun; Mr James Wylie, Royal Bank, Leith.

Treasurer—Mr David Wilson, D.Sc., of Carbeth, Killearn.

Honorary Secretary—Mr Alexander Cross of Knockdon, 19 Hope Street, Glasgow.

Edinburgh Show, 1915.

Sir ARCHIBALD BUCHAN HEPBURN of Smeaton, Bart., submitted the following Report by the Directors regarding the postponement of the Edinburgh Show of 1915: "The Board of Directors, at their Meeting on 7th April, decided, by an overwhelming majority, not to proceed with the Annual Show arranged to be held in Edinburgh this year.

"The results of inquiries addressed to the Military Authorities regarding the advisability of holding the Show, and to the Caledonian Railway Company as to the probability of the usual railway facilities being available, were reported by the Chairman. No written reply had been received from the Scottish Command Headquarters, but the Secretary had been informed verbally that at present the Scottish Command did not propose to forbid the holding of the Show. At the same time the Military Authorities could not relax, even temporarily, their requirement that the Railway Companies should keep a definite number of horse-boxes immediately available at specified centres, and as all the railway sidings in the vicinity of the Showyard were included in the Military scheme of organisation, any unexpected emergency would have the effect of immediately withdrawing all railway facilities from the Show. In such an event the convenience of exhibitors or visitors could not be considered, and no claim for compensation would be entertained.

"The Caledonian Railway Company expressed the hope that the same facilities would be afforded this year as had been given on former occasions.

"The Directors fully appreciated the difficulties of the problem which confronted them, and the many important considerations which might be advanced both for and against the holding of the Show.

"On the one hand it was recognised, with much regret, that the postponement of the Show would entail hardship on exhibitors of both stock and implements. The former had incurred expense in preparing animals for the Show, and would be deprived of an opportunity of showing their animals and of carrying through those transactions which have come to be a regular feature of the Exhibition. In the case of all exhibitors the lack of this opportunity of transacting business would be severely felt, and this was especially to be regretted at a time when it was desirable that the breeding of stock and the increased production of all farm crops should receive every encouragement.

"On the other hand, it was urged that under present circumstances the Show could not be other than of a local character. Instances were given where during the past six months it had been found impossible to get farm stock and produce carried by the Railway Companies except after much delay, extending in some cases to two or three weeks. In view of the possibility of such delays, it was believed that exhibitors of stock would not run the risk of sending valuable animals from a distance, with the likelihood of their arriving in the Showyard much deteriorated in condition.

"It was felt that while the Railway Companies might not at present raise any definite objection to the holding of the Show, they could not foresee all the difficulties which might arise. It was obvious that a crisis in the war was being approached which would probably be reached at or near the date of the Show. No one could tell how long this critical stage would last, but if the railways were required during that time for military purposes, then the Show would have to be abandoned at the last moment, thereby entailing great loss and inconvenience.

"While the Directors did not feel that the risk of financial loss alone should out-

weigh other considerations in arriving at a decision, it was pointed out that the cost of the necessary timber for the erection of the Showyard would be increased from approximately £4500 to £7200, and that on this item alone, apart from the prospect of greatly reduced drawings, a very considerable loss might be entailed, for which the Society could not well avoid some degree of responsibility. In the event of the Show being stopped at the last moment the loss would be much more serious.

"On the general question of the feeling of members throughout the country in regard to holding the Show, it was pointed out that many of the Society's most loyal supporters were at present on active military service, while some had lost their lives. Many others were mourning the loss of relatives or were suffering from deep anxiety, and under the circumstances could not be expected to attend the Show. While the importance of the Meeting as an occasion for business could not be forgotten, it was urged that by the great majority of visitors to the Show it was regarded more in the nature of an annual outing. It was therefore felt that the Society in holding the Show would not have the sympathy of the great majority of the people of the country, and that its postponement, under the present regrettable circumstances, would be regarded by them as a thoughtful and considerate act.

"In dealing with a question of admitted difficulty, as to which considerations of great weight presented themselves on both sides, the Directors, while recognising the hardships involved in the abandonment of the year's Show, were convinced that the balance of advantage is in favour of the course adopted, and that it will meet with the general approval of members of the Society, of agriculturists, and of the public."

In moving the adoption of the report, Sir Archibald said that those were abnormal times, and every one must be prepared to suffer hardship more or less. The course which the Directors had taken appeared to have met with the approval of the public.

Mr J. M'HUTCHEN DOBBIE, Campend, Dalkeith, seconded. No doubt there was a small minority who thought the Directors had done wrong in this matter, but, on the whole, he believed the Board had acted wisely.

Mr JOHN ELDER, Berwick-on-Tweed, asked where the Directors got their authority for abandoning the Show after the General Meeting at Hawick in July last, and the January Meeting of the members had approved of its being held. It was not until April that they resolved to abandon the Show. One reason given was that timber was at such a high price, but if so the contractor would get so much the more when he came to sell it. Those who wanted the Show to go on were just as loyal as those who favoured putting it off. In a short time in the Edinburgh market forty-one members signed a protest against what had been done, and asked that a General Meeting should be held to reconsider the matter. Why was no attention paid to that petition? If the present circumstances did not justify the Directors in calling a Special Meeting of members, what circumstances would justify their doing so?

Mr CHARLES DOUGLAS, D.Sc., of Auchlochan, as Chairman of Directors, explained the position. The Directors, under the Charter, were empowered to take charge of the general affairs of the Society, apart from certain things which were reserved. Whatever was not specially reserved it was proper for the Directors to do. The Society was governed on the principle, not of collective action or the referendum, but on the principle of representation. It was the intention of the Directors in January to go on with the Show in July of this year. It would have been an unwise decision to have canvassed the expediency of holding the Show. The surest way to foredoom the Show to failure was to do that, if they determined to go on with the Show. For himself, he was of a somewhat different opinion from the majority of his colleagues. The decision was most emphatic, and clearly represented the opinion of the great majority of the members of the Society. The procedure was in strict accordance with the Charter of the Society. It was always possible in connection with a local Society to hold a General Meeting, but with a national Society of 7000 members that was not possible, and the cases in which such Meetings should be held were left to the discretion of the Directors. On the merits of the question a good deal could be said on both sides. He would be very sorry to suggest that those in favour of holding the Show were less patriotic than those who favoured not holding it, but the extent to which commandeering was going on went far to justify the course which the Directors had taken. The Directors might call a Special Meeting when so advised. The responsibility for calling such rested on them. They would be at fault if they called a Special Meeting without excuse. He denied that the application from the forty-one members met with anything but courtesy. No member of the Board moved that a Meeting should be called, or that special necessity existed for calling such a Meeting.

The Report was then approved.

Shows of 1916, 1917, and 1918.

Mr DOUGLAS reported that the Board of Directors, in view of the decision not to proceed with the Show arranged to be held in Edinburgh this year, recommended as follows: That the Resolutions regarding the holding of the Shows at Edinburgh, Aberdeen, and Stirling, passed at the Anniversary General Meetings on 8th January 1913, 7th January 1914, and 6th January 1915 respectively, be rescinded; and further, that the decision of the Directors that the next Show of the Society be held at Edinburgh, and that the subsequent Shows be held at Aberdeen and Stirling, according to the ordinary rotation, be approved.

Mr W. T. MALCOLM seconded approval of the Board's recommendations, and these were adopted.

Election of Office-bearers.

Mr DOUGLAS presented a Report by the Directors on the resolution passed at the Meeting of Members in the Showyard at Hawick, on 15th July 1914, regarding the election of Office-bearers (see page 311).

The Report was approved.

Extraordinary Directors.

Mr DOUGLAS submitted the following motion: "That the following Bye-law be adopted: 'The Board shall not recommend a Director for extraordinary election for more than two years in succession.'" He said this was an attempt to deal, and he hoped to deal adequately, with a grievance which had long occupied the time of their meetings. The difficulty was to reconcile the demand for "new blood" with the advantages of experience. By the more recent bye-laws ordinary Directors, after serving a full term of four years, were not eligible for re-election as such until after the lapse of one year. The Directors had the power to nominate any one of such as an Extraordinary Director, and the resolution he now proposed limited that power to two years and no more. It did not circumscribe the power of the constituencies to elect, but it limited the power of Directors to nominate to two years.

Mr THOMAS ELDER, Stevenson Mains, seconded. He gave a short account of the history of the question which had agitated the Society for some years. It had two phases—the re-election of ordinary Directors, and the nomination of retiring ordinary Directors as Extraordinary Directors. The first phase had been disposed of two years ago; they were disposing of the second phase now. The question had been acute. Some thought that an ordinary Director should not be eligible for nomination as an Extraordinary Director until after he had been out of office as an ordinary Director for one year. Others took the view that an ordinary Director should be eligible for nomination as an Extraordinary Director right away. A compromise was effected by the proposed bye-law, which conceded this power but limited its exercise to two years. He hoped this would put the question so that it would be sunk for ever, and that the new bye-law would work smoothly.

The motion was agreed to.

Show Divisions.

Mr CHARLES DOUGLAS moved—"That when the bye-laws are reprinted, the words 'Show Division' be substituted for 'Show District' wherever these words occur."

The motion was seconded by Mr A. H. ANDERSON, and unanimously agreed to.

Agricultural Education.

Mr ALEXANDER CROSS of Knockdon submitted the Report on the examination held at Leeds in April last for the National Diploma in Agriculture. 101 candidates presented themselves for examination. 38 candidates were from Scotland.

As a result of the examination 38 diplomas were awarded—3 with honours.

Of the 101 candidates 4 appeared for all the subjects, and of these 1 obtained the diploma. This candidate, a student of the Edinburgh University and East of Scotland College of Agriculture, took second place in honours. 50 had passed certain subjects in 1914 and were completing the examination this year, and of these 35

obtained the diploma—2 with honours. The remaining 47 candidates presented themselves for a group of three or four subjects, and of these 25 passed in the subjects for which they appeared, and are entitled to appear for the remaining subjects in 1916.

The first and third places in honours were obtained by students of the Glasgow University and West of Scotland Agricultural College.

Forestry Department.

Sir ARCH. BUCHAN HEPBURN, Bart., reported that the Society's Examination for First and Second Class Certificates in Forestry was held from the 30th March to 1st April last, when 5 candidates presented themselves for examination. Two of the candidates were successful in obtaining the First Class Certificate, and one obtained the Second Class Certificate.

Grant to Edinburgh Agricultural Association.

Dr DAVID WILSON, Convener of the Finance Committee, moved that a Special Grant of £100 be given to the Edinburgh Agricultural Association towards the expenses of the Association's Show, to be held in Edinburgh this year.

Mr J. T. M'LAREN, Dalmeny, seconded, and the grant was agreed to.

Chemical Department.

Dr J. F. TOCHER, Chemist to the Society, submitted a report on the work done in this department.

The substance of Dr Tocher's report appears in another part of this volume.

Botanical Department.

The following Report by Professor A. N. M'ALPINE, Botanist to the Society, was submitted by Dr R. Shirra Gibb:—

I have the honour to report that during the season 1914-15 I have tested the purity and germination of 140 samples of agricultural seeds.

There has been no falling off in the purity and germination of the seeds sent in except in one Timothy sample, which germinated only 60 per cent, and in one Crested Dogstail sample, which germinated only 60 per cent.

The accompanying table shows the maximum and minimum percentages of purity and germination of the grass and clover seeds tested for the present season (1915):—

	Purity percentage.		Germination percentage.	
	Maximum.	Minimum.	Maximum.	Minimum.
Red clover . . .	99	98	98	92
Alsike clover . . .	97	92	100	91
White clover . . .	99	97	99	92
Perennial ryegrass . . .	99	91	99	91
Italian ryegrass . . .	99	94	94	89
Timothy . . .	99	96	98	90
Cocksfoot . . .	100	91	93	89
Meadow fescue . . .	100	99	100	98
Tall oat . . .	100	96	91	90
Crested Dogstail . . .	99	...	93	...

ANNIVERSARY GENERAL MEETING, 12TH JANUARY 1916.

The Right Hon. The EARL OF ROSEBURY, K.G., K.T., President of the Society,
in the Chair.

New Members.

9 candidates were balloted for and elected Members of the Society.

Vacancy on Board of Directors.

On the recommendation of the Board of Directors, Mr Harry Hope, M.P., Barneyhill, Dunbar, was elected an Extraordinary Director for one year in room of the late Mr James Wylie, Edinburgh.

Finance.

Dr DAVID WILSON of Carbeth, Convener of the Finance Committee, submitted the Accounts of the Society for the year to 30th November 1915. The receipts for the year from all sources reached a total of £6245, 6s. This sum, which includes life subscriptions to the amount of £590, 11s., exceeds the outlays by £372, 1s. 1d. In the past year the expenditure on educational work amounted to £149, 3s. 6d., and no work in the chemical and botanical departments to £185, 14s. 6d.

He moved the approval of the usual grant of £20 to the Scottish Meteorological Society, and £5 to the Society for the Prevention of Cruelty to Animals, for the year 1916.

Mr GEORGE W. CONSTABLE, Traquair Estate Office, seconded, and the Accounts were approved.

Argyll Naval Fund.

Sir ARCHIBALD BUCHAN HEPBURN of Smeaton, Bart., submitted the Report on the Argyll Naval Fund for 1914-15, which showed that the income for the year amounted to £291, 12s. 8d., while the expenditure was £220 in grants of £40 to five naval cadets, and one special grant of £20.

One vacancy occurred in the list of beneficiaries through the promotion of Lieutenant Francis Grant Hunter. It was decided to fill this vacancy, and also, in view of the state of the funds, to place a sixth beneficiary on the list, and the following were appointed: Thomas Ian Scott Bell and Rowland E. S. Hugonin.

Mr D. A. STEWART, Lochdhu, seconded, and the Report was approved.

Show of 1916.

Sir ARCHIBALD BUCHAN HEPBURN reported that the Directors had decided that in the present circumstances no steps should be taken towards holding a Show this year. This decision was arrived at on a report from the Shows Committee, which Committee had taken steps to ascertain the views of the Railway Companies, implement exhibitors, and others, and had given the whole subject its most careful consideration.

Alteration of Bye-laws.

Mr CHARLES DOUGLAS, D.Sc., Chairman of Directors, moved that the following resolutions, which were approved by the Board Meetings on 7th April and 2nd June 1915, and by the Half-Yearly Meeting of Members on the latter date, be confirmed in terms of the Charter:—

(1) "That the following Bye-law be adopted: 'The Board shall not recommend a Director for Extraordinary election for more than two years in succession.'"

(2) "That when the Bye-laws are reprinted, the words 'Show Division' be substituted for 'Show District' wherever these words occur."

Mr JAMES M'QUEEN of Crofts seconded, and the resolutions were duly confirmed.

Mr DOUGLAS moved approval of the following resolution, which had been adopted by the Directors on 2nd June, and duly notified to the Board on 1st December 1915 and 12th January 1916, in terms of the Charter:—

"That the following words be added after the words 'Veterinary Surgeons' in line 6, Bye-law No. 2:—

'and such other persons as, in respect of their official or other connection with Agriculture, the Board of Directors may consider eligible.'"

Mr M'QUEEN seconded, and the resolution was duly approved.

Subscription by Members.

The following motion appeared on the agenda in name of Mr J. LYON GUILD:—

“That in view of the fact that no Show was held last year, and the probability of there being no Show in the current year, the Society considers it unnecessary to collect the annual subscriptions now due.”

At the request of the Chairman, the Secretary read the following letter from Messrs Tods, Murray, & Jamieson, W.S., the Society's law agents, regarding the competency of the proposals contained in the motion:—

JOHN STIRTON, Esq., *Secretary*,
The Highland and Agricultural
Society of Scotland,
3 George IV. Bridge, Edinburgh.

66 QUEEN STREET, EDINBURGH,
7th January 1916.

DEAR SIR,

SUBSCRIPTIONS OF MEMBERS.

Referring to your letter of the 5th inst., we have considered the two questions upon which an opinion is desired.

(1) The motion proposed to the following effect:—

“That in view of the fact that no Show was held last year, and the probability of there being no Show in the current year, the Society considers it unnecessary to collect the annual subscriptions now due.”

The Charter of 1834 in the head or section “Sixth” deals with annual contributions. These are to consist of such sum or sums as the Society may from time to time fix and declare by any regulation or bye-law. The amount of the annual contributions may therefore be from time to time regulated by bye-law, but some annual contribution appears to be required by the Charter from all ordinary members other than those who have redeemed their yearly contributions. If, therefore, the proposed motion contemplates that the annual subscriptions now due shall not be collected at all, the motion appears to be contrary to the terms of the Society's Charters. If it is intended merely to defer the date for payment of the subscriptions, the motion might be within the powers of the Society, but it would require to be made a bye-law by the usual procedure, and the date to which payment is to be postponed should be stated.

(2) Competency of a motion to *reduce* the amount of the annual subscription.

In view of the power conferred upon the Society by the Charter of 1834 to fix and determine by regulation or bye-law the sum to be paid annually by ordinary members, it is competent to entertain a motion for the amendment of the existing bye-laws so as to *reduce* the annual contributions. A motion of this nature requires to be notified at two meetings of the Directors before being submitted to the Society. We assume that in the meantime no motion for the reduction of the subscription has been notified, and if this be so, a motion would not be competent at the meeting on the 12th inst. for the passing of a resolution amending the existing bye-laws on the subject of members' subscriptions. If the amounts of the annual subscriptions are altered, the sums to be paid for their redemption should also be regulated.—We are, yours faithfully,

(Signed) TODS, MURRAY, & JAMIESON.

Mr CHARLES DOUGLAS said the members had heard the terms of the letter from the law agents, which he presumed they would find themselves bound to regard as conclusive against the motion about to be proposed. The Directors had considered this matter, and he had been asked to indicate their views. The Directors were most reluctant that a discussion on this subject should appear to be burked on any technical ground arising out of unfamiliarity of the mover with the details of the Charter, and they suggested that the motion might be brought within the limits of order by inserting certain words which would give the resolution a more suspensory character. He therefore suggested that following the word “unnecessary” in the resolution they should insert the words “in the meantime.” The Directors, while suggesting this way of avoiding the mere technical destruction of the motion, were none the less unanimously opposed to the substance of the motion and to the proposal involved. The Directors deeply regretted that no Show was held last year, and that they were compelled by the advice they had received from the Railway

Companies' Management to suspend their judgment as to whether a Show should be held this year or not. It seemed to be assumed that the Society did not make money out of its Shows, and that when no Show was held the members did not receive benefit. As a matter of fact, taking the last Show circuit, there was an average profit on each Show of £300 annually. It was not the case that nothing else was given to the members but privileges connected with the Shows. The 'Transactions' cost £1062 in round figures, the Chemical Department £155, the Botanical Department £100, and other forms of enterprise £270, making a total of £1587 annually spent for the benefit of the members. The amount received from subscriptions annually was £1333. The membership consisted of two-thirds life members and one-third annual members, and if Mr Guild's motion was carried, it would mean making a gift of £1300 in round figures to the annual members at the expense of the life members. The Highland and Agricultural Society was recognised by the Income Tax Commissioners as a benevolent institution, existing for the purpose of promoting industry, and especially industrial improvement in the Highlands, and because of that they had received back from the Income Tax Commissioners the amount levied upon them annually in name of income tax, which came to about £450 per annum. If they were to decide that because they had no Show they were not entitled to exact annual subscriptions, they would be admitting that they were a trading organisation and not an organisation existing for a benevolent purpose. The position of the Society financially was seriously impaired by the condition of the country. The capital was reduced in value by £12,000 through depreciation in the investments during 1915. There was therefore no reason for relieving some of the members of their liability. The estimates for the current year showed that there was a narrow margin between income and expenditure, and the proposal in Mr Guild's motion, if given effect to, would almost extinguish that margin. Beyond that he wished to say, although he did not make it an argument, that they would be expected to make a very substantial contribution in aid of their Allies in Belgium at the proper time. They were practically committed to that, and it would be a poor thing when the time arrived, through taking such action as Mr Guild proposed, if they found themselves unable to do so as liberally as they desired. For these reasons the Board felt constrained to oppose Mr Guild's motion, even if he was prepared to put it forward in the amended form which had been suggested.

Mr J. LYON GUILD said he had been put to considerable difficulty in two respects. He was faced with the opinion of the law agents, and by the fact that Mr Douglas had replied to his speech before it had been delivered. He was a little surprised that the Directors, who had held no Show for two years, should not at the same time have taken their courage in both hands and intimated that they had resolved to reduce the subscription as far as possible. There were three reasons why the motion should be approved: first, on the ground of economy. They had heard from the members of the Government individually and severally that the people should do everything they possibly could to economise. So far as he had been able to judge, the policy advocated by the Government hadn't been put into operation. However, he thought the Highland and Agricultural Society should show the example and reduce the subscription. It had been said that farmers had done well last year. He was not prepared to dispute this, but from his practical experience he could see that the year 1916 was not going to be so prosperous. With the purchase price of everything so much increased, the balance of last year would be considerably eaten up before the present twelve months were out. His second point had reference to inexpediency. The leading Agricultural Society of Scotland had a very large command of capital. He was sorry that in this connection they had been following up rather than leading. Many other Societies had intimated that they were not going to hold Shows this year, and that being so they didn't propose to levy the annual subscription. Why, he asked, should the leading Society in Scotland be behind others in this matter? It had been said that there might be an objection on the part of the life members if this proposal were adopted. He had been a life member for forty years, and he regarded it as the best investment he had ever made. It seemed to him an extraordinary way of popularising the Society by holding no Show for two years and at the same time drawing subscriptions. His third reason was that it was unnecessary to levy the subscription. Taking the balance-sheet of 1913-14, he found that the income derived by the Society from investments was something like £4000, while the life members and annual subscriptions amounted to £2000 per annum. Taking the discharge side of the account he found that the cost of the establishment and departments was £3500. That didn't include grants to other Societies, many of which would not be holding Shows, and therefore it would be unnecessary for the Highland to make any grants. He understood that very considerable investments had been made by the Directors which would appear on the charge side of the balance-sheet.

As there was no seconder the motion fell.

Royal (Dick) Veterinary College.

Dr WILSON, Convener of the Finance Committee, reported that the Directors had considered the letter of application for a further grant towards the Building Fund of the Royal (Dick) Veterinary College. The Directors, he said, did not see their way to recommend a further grant to the College at the present time. There appeared to be no hope of the College raising sufficient funds, under present circumstances, to bring the new buildings to such a state of completion that students could be accommodated, and any sum the Society could give at the present time would be entirely inadequate for this purpose. Owing to the present cost of building it was evident that a subscription given after the war would have very much greater effect than the same amount given now. The Directors further felt bound to recognise that the present number of students was largely reduced. These were being accommodated in the old College buildings, and it was urged that that arrangement might be continued throughout the duration of the present abnormal conditions.

In supplementing the report, Dr Wilson stated that they were informed that the minimum sum requisite to put the building in a state to receive students was £10,000. Of that sum £5000 might be received in grants from Government Departments. He accordingly moved approval of the Report.

Mr G. B. SHIELDS, Dolphinton, seconded, and the Report was adopted.

District Shows and Competitions.

Mr WILLIAM ELLIOT, Lanark, submitted the Report on the District Shows and Competitions, showing that in 1915 grants of money and medals had been given in 97 districts. The total expenditure under this head amounted to £415, 10s. 7d. For the current year the Directors proposed the following grants: (1) Under section 1, sixteen districts for grants of £12 each for cattle, horses, and sheep, and thirteen districts in intermediate competition with a grant of three silver medals to each; (2) under section 2, eleven districts for grants of £15 each for stallions; special grants of £40 to the Highland Home Industries; £20 to Kilmarnock Cheese Show; two silver medals to Ross-shire Crofters' Club; £5 to Shetland; £3 each to Unst, Orkney, Sanday, and North Uist; a gold medal and a silver medal to the British Dairymaids' Association; sixteen districts for two medals each; about 100 medals at ploughing competitions; three medals for hoeing competitions; two medals each to six districts for cottages and gardens; Long Service Medals and Certificates, say £50—making the total sum offered in 1916, £690.

Chemical Department.

Dr J. F. TOCHER, Consulting Chemist to the Society, reported on the work of his department during 1915.

The substance of Dr Tocher's Report appears in another part of this volume.

Implement Trials.

Mr DAVID FERRIE, Parbroath, in the absence of Mr J. T. M'Laren, Convener of the Implement Trials Committee, reported that an Exhibition Trial of Motor Tillage Implements was held at Stirling on 5th and 6th October 1915, and was subsequently repeated, at the request of agricultural societies in the North of Scotland, as a Demonstration at Allanfearn, Inverness, on 16th October. The Trials were largely attended, and much interest was evinced in them by agriculturists throughout the country. An official Report on the Trial at Stirling had been prepared and published, and copies were laid on the table.

A copy of the Report appears in another part of this volume.

Education.

Mr ALEXANDER CROSS of Knockdon reported on the results of the twentieth examination held last autumn for the National Diploma in Dairying. At the examination in England there were 23 candidates, of whom 15 obtained the diploma and 8 failed; at the examination at Kilmarnock there were 28 candidates, 22 getting the diploma and 6 failing. The names of the successful candidates, as well as the names of the winners of the National Diploma in Agriculture at the Examination held last May, will be published in the next volume of 'Transactions.'

The examinations for these diplomas will again be held during the ensuing year.

The Society's examinations for First and Second Class Certificates in Forestry, which are held in alternate years, will be held in 1917.

Publications.

Mr DOUGLAS reported that the annual volume of 'Transactions' was being prepared, and would be published in the spring.

Scottish Agricultural Committee for Belgian Repatriation.

Mr DOUGLAS, Chairman of the Committee, reported that, as agreed upon at the General Meeting in January 1915, a Committee had been formed, under the auspices of the Highland and Agricultural Society and the Scottish Chamber of Agriculture, with the object of assisting in the repatriation of Belgian farmers, by providing them with potato and other agricultural seeds, and with farm stock and implements, at the appropriate time for doing so after their country has been cleared of invaders.

The Committee had received the patronage of the Belgian Government, and Lord Rosebery had kindly agreed to act as its President. The Committee had been further strengthened by the co-option of representative agriculturists from every district of the country, and by the addition of representatives of the various Breed Societies and of the Implement Trade and the Seed Trade.

A number of meetings had been held, and arrangements had been made for the establishment of Committees in every county of Scotland for the purpose of soliciting and receiving contributions in money and in kind. These County Committees were to consist mainly of representatives appointed by the local Agricultural Societies in each county, together with Directors of the Highland and Agricultural Society and of the Scottish Chamber of Agriculture resident in the county.

The local Agricultural Societies responded readily to the invitation to nominate representatives to the County Committees, and over 250 gentlemen have been duly appointed. The intention of the Central Committee was, after these appointments had been made, to summon meetings of the representatives in each county for the purpose of appointing a County Chairman and Secretary, and proceeding with the organisation within the county.

The hopes entertained a year ago that Belgium would be cleared at an early date have, however, not yet been realised. It is felt, and this view is strongly held by the President of the Committee, that to proceed with the repatriation scheme in the meantime would tend to hamper the many laudable efforts for Belgian relief which are being undertaken throughout the country. It is realised that Relief work has the foremost claims on the generosity of the people of this country—agricultural and otherwise—at the present time; and it is felt that the scheme for Belgian agricultural repatriation, which has already made satisfactory progress in the direction of establishing a suitable organisation in each county, may be allowed to rest until such time as the evacuation of Belgium and the return of the people to their own land appears within sight of realisation.

APPENDIX

PREMIUMS

OFFERED BY

THE HIGHLAND AND AGRICULTURAL SOCIETY OF SCOTLAND IN 1916

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GENERAL NOTICE.

THE HIGHLAND SOCIETY was instituted in the year 1784, and incorporated by Royal Charter in 1787. Its operation was at first limited to matters connected with the improvement of the Highlands of Scotland; but the supervision of certain departments, proper to that part of the country, having been subsequently committed to special Boards of Management, several of the earlier objects contemplated by the Society were abandoned, while the progress of agriculture led to the adoption of others of a more general character. The exertions of the Society were thus early extended to the whole of Scotland, and have since been continuously directed to the promotion of the science and practice of agriculture in all its branches.

In accordance with this more enlarged sphere of action, the original title of the Society was altered, under a Royal Charter, in 1834, to **THE HIGHLAND AND AGRICULTURAL SOCIETY OF SCOTLAND**.

Among the more important measures which have been effected by the Society are—

1. Agricultural Meetings and General Shows of Stock, Implements, &c., held in the principal towns of Scotland, at which exhibitors from all parts of the United Kingdom are allowed to compete.
2. A system of District Shows instituted for the purpose of improving the breeds of Stock most suitable for different parts of the country, and of aiding and directing the efforts of Local Agricultural Associations.
3. The encouragement of Agricultural Education, under powers conferred by a supplementary Royal Charter, granted in 1856, and authorising the Society to grant Diplomas to Students of Agriculture; and by giving grants in aid of education in Agriculture and allied sciences. In 1900 the Society discontinued its own Examination, and instituted jointly with the Royal Agricultural Society of England an Examination for a National Diploma in Agriculture.
4. The advancement of the Veterinary Art, by conferring Certificates on Students who have passed through a prescribed curriculum, and who are found, by public examination, qualified to practise. Terminated in 1881 in accordance with arrangements with the Royal College of Veterinary Surgeons.
5. The institution of a National Examination in Dairying, jointly with the Royal Agricultural Society of England.
6. The institution of an Examination in Forestry for First and Second Class Certificates.
7. The appointment of a chemist for the purpose of promoting the application of science to agriculture.
8. The establishment of a Botanical Department.
9. The appointment of Entomologist to advise members regarding insect pests.
10. The annual publication of the 'Transactions,' comprehending papers by selected writers, Prize Reports, and reports of experiments, also an abstract of the business at Board and General Meetings, and other communications.
11. The management of a fund left by John, 5th Duke of Argyll (the original President of the Society), to assist young natives of the Highlands who enter His Majesty's Navy.

CONSTITUTION AND MANAGEMENT.

The general business of **THE HIGHLAND AND AGRICULTURAL SOCIETY** is conducted under the sanction and control of the Royal Charters, referred to above, which authorise the enactment of Bye-Laws.

The Office-Bearers consist of a President, Four Vice-Presidents, Thirty-two Ordinary and Twenty Extraordinary Directors, a Treasurer, an Honorary and an Acting Secretary, an Auditor, and other Officers.

The Supplementary Charter of 1856 provides for the appointment of a Council on Education, consisting of Sixteen Members—Nine nominated by the Charter, and Seven elected by the Society.

PRIVILEGES OF MEMBERS

MEMBERS OF THE SOCIETY ARE ENTITLED—

1. *To receive a free copy of the 'Transactions' annually.*
2. *To apply for District Premiums that may be offered.*
3. *To report Ploughing Matches for Medals that may be offered.*
4. *To Free Admission to the Shows of the Society.*
5. *To exhibit Live Stock and Implements at reduced rates.¹*
6. *To have Manures and Feeding-Stuffs analysed at reduced fees.*
7. *To have Seeds tested at reduced fees.*
8. *To have Insect Pests and Diseases affecting Farm Crops inquired into.*
9. *To attend and vote at General Meetings of the Society.*
10. *To vote for the Election of Directors, &c., &c.*

ANALYSIS OF MANURES AND FEEDING-STUFFS

The Fees of the Society's Chemist for Analyses made for Members of the Society shall, until further notice, be as follow :—

The estimation of one ingredient in a manure or feeding-stuff	:	:	:	5s.
The estimation of two or more ingredients in a manure or feeding-stuff	:	:	:	10s.

These charges apply only to analyses made for the sole and private use of Members of the Highland and Agricultural Society who are not engaged in the manufacture or sale of the substances analysed.

The Society's Chemist, if requested, also supplies valuations of manures, according to the Society's scale of units.

SEEDS, CROP DISEASES, INSECT PESTS, &c.

The rates of charges for the examination of plants and seeds, crop diseases, insect pests, &c., will be had on application to the Secretary.

ELECTION OF MEMBERS

Candidates for admission to the Society must be proposed by a Member, and are elected at the half-yearly General Meetings in January and June. It is not necessary that the proposer should attend the Meeting.

CONDITIONS OF MEMBERSHIP

Higher Subscription.—The ordinary annual subscription is £1, 3s. 6d., and the ordinary subscription for life-membership is £12, 12s.; or after ten annual payments have been made, £7, 7s.

Lower Subscription.—Proprietors farming the whole of their own lands, whose rental on the Valuation Roll does not exceed £500 per annum, and all Tenant-Farmers, Secretaries or Treasurers of Local Agricultural Associations, Factors resident on Estates, Land Stewards, Foresters, Agricultural Implement Makers, and Veterinary Surgeons, none of them being also owners of land to an extent exceeding £500 per annum, are admitted on a subscription of 10s. annually, which may be redeemed by one payment of £7, 7s., and after eight annual payments of 10s. have been made, a Life Subscription may be purchased for £5, 5s., and after twelve such payments, for £3, 3s.² Subscriptions are payable on election, and afterwards annually in January.

Members are requested to send to the Secretary the names and addresses of Candidates they have to propose (stating whether the Candidates should be on the £1, 3s. 6d. or 10s. list).

JOHN STIRTON, *Secretary.*

3 GEORGE IV. BRIDGE, EDINBURGH.

¹ Firms are not admitted as Members; but if one partner of a firm becomes a Member, the firm is allowed to exhibit at Members' rates.

² Candidates claiming to be on the 10s. list must state under which of the above designations they are entitled to be placed on it.

ESTABLISHMENT FOR 1915-1916

President.

THE EARL OF ROSEBERY, K.G., K.T., Dalmeny Park, Edinburgh.

Vice-Presidents.

The EARL OF HADDINGTON, Tynninghame, Prestonkirk.
The MARQUIS OF LINLITHGOW, Hopetoun House, South Queensferry.
Colonel WARDLAW RAMSAY of Whitehill, Rosewell.
Major F. J. CARRUTHERS of Dormont, Lockerbie.

Year of
Election.

Directors.

1912	JOHN M'HUTOHEN DOBBIE, Campend, Dalkeith.
	ARTHUR B. NICOLSON of Glenbervie, Fordoun.
	DUNCAN STEWART of Millhills, Crieff.
	ROBERT MACMILLAN of Holm of Dalquhairn, Woodlea, Moniaive.
	D. P. HENDERSON of Stemster, Halkirk, Caithness (<i>Elected Jan. 1915</i>).
	HUGH MARTIN, Flowerdale, Kinrossie, Perth (<i>Elected June 1915</i>).
	ROBERT C. YOUNG of Shoddesden, Netherfield, Johnstone.
	HUGH M. LEADBETTER, Knowesouth, Jedburgh.
	GEORGE BEAN, West Ballochry, Montrose.
	PETER MACINTYRE, Tighnablaair, Comrie.
1913	WALTER BIGGAR, Grange Farm, Dalbeattie.
	WILLIAM MACDONALD, Strowan, Annfield Road, Inverness.
	W. STEUART FOTHERINGHAM, of Fotheringham and Murthly, Murthly.
	Sir HUGH SHAW STEWART, Bart., of Greenock and Blackhall, Ardgowan, Greenock.
	LORD DUNGLASS, Springhill, Coldstream.
	Sir HENRY DUNDAS, Bart., Polton House, Lasswade.
	Colonel G. J. FERGUSON-BUCHANAN of Auchentorlie, Bowling.
1914	JAMES M'QUEEN of Crofts, Dalbeattie.
	D. A. STEWART, Lochdhu, Nairn.
	R. D. THOM of Pitlochrie, Gateside.
	WILLIAM ELLIOT, Lanark.
	GEORGE W. CONSTABLE, Traquair Estate Office, Innerleithen.
	G. BERTRAM SHIELDS, Dolphingstone, Tranent.
	A. F. IRVINE of Drum, Drumoak.
1915	MURRAY LITTLE, Summerhill, Annan.
	P. B. MACINTYRE, Finden Mains, Conon Bridge.
	WILLIAM MUNGALL of Transy, Dunfermline.
	Major W. T. R. HOULDSWORTH, Kirkbride, Maybole.
	SAMUEL STRANG STEEL of Philiphaugh, Selkirk.
	JAMES ELDER, Athelstaneford Mains, Drem.
	JOHN P. SLEIGH, St John's Wells, Fyvie.
	WILLIAM CARRICK, The Baad, Stirling.

Extraordinary Directors.

- 1914 { DAVID FERRIE, Parbroath, Cupar-Fife.
J. ERNEST KERR of Harviestoun Castle, Dollar.
ARCHIBALD WHYTE, Inverquhar, Kirriemuir.
CHARLES DOUGLAS, D.Sc., of Auchlochan, Lesmahagow.
1915 { Sir ARCHIBALD BUCHAN HEPBURN of Smeaton, Bart., Prestonkirk.
ROBERT MACDIARMID, Corries, Lochawe.
The Hon. A. D. MURRAY, Scones Lethendy, Perth.
C. H. SCOTT PLUMMER of Sunderland Hall, Selkirk.
WILLIAM POOLE (A. & J. Main & Co., Ltd.), Englewood, Blackhall.
JOHN C. ROBERTSON, Fodderty, Dingwall.

Show District.

- Right Honourable Sir ROBERT KEITH INCHES, Lord Provost of
Edinburgh, 2 Strathearn Road, Edinburgh.
Brig.-General R. GORDON GILMOUR of Craigmillar, The Inch, Liberton.
JAMES ALLISON, Clifton Mains, Ratho.
1914. J. STEWART CLARK of Dundas Castle, South Queensferry.
1915 J. INGLIS DAVIDSON, Saughton Mains, Corstorphine.
THOMAS ELDER of Stevenson Mains, Haddington.
HARRY HOPE, M.P., Barneyhill, Dunbar.
J. T. M'LAREN, The Leuchold, Dalmeny Park, Edinburgh.
J. M. MARTIN, 111 Elgin Crescent, Nottinghill, London, W.
A. AGNEW RALSTON, Philpstoun House, Philpstoun.

Office-Bearers.

DAVID WILSON, D.Sc., of Carbeth, Killoarn, *Treasurer*.
ALEX. CROSS of Knockdon, 19 Hope Street, Glasgow, *Honorary Secretary*.
Rev. A. WALLACE WILLIAMSON, D.D., 44 Palmerston Place, *Chaplain*.
JOHN STIRTON, *Secretary*.
EDWARD M. COWIE, *Chief Clerk and Cashier*.
A. S. CAVERS, *Second Clerk*.
WILLIAM HOME COOK, C.A., 42 Castle Street, *Auditor*.
J. F. TOUCHER, D.Sc., F.I.C., 41½ Union Street, Aberdeen, *Chemist*.
Professor R. STANFIELD, A.R.S.M., M.Inst.C.E., F.R.S.E., 24 Mayfield
Gardens, Edinburgh, *Consulting Engineer*.
A. N. M'ALPINE, 6 Blythswood Square, Glasgow, *Consulting Botanist*.
R. S. MACDOUGALL, M.A., D.Sc., 9 Dryden Place, *Consulting Entomologist*.
TODS, MURRAY, & JAMIESON, W.S., 66 Queen Street, *Law Agents*.
WILLIAM BLACKWOOD & SONS, 45 George Street, *Publishers*.
HENRY MUNRO, Ltd., 82 Mitchell Street, Glasgow, *Advertising Agents*.
HAMILTON & INCHES, Princes Street, *Silversmiths*.
ALEXANDER KIRKWOOD & SON, 9 St James' Square, *Medallists*.
D. MACANDREW & Co., 120 Loch Street, Aberdeen, *Showyard Contractors*.
ANDREW BROWN, *Messenger*.

Chairman of Board of Directors.

CHARLES DOUGLAS, D.Sc., of Auchlochan, Lesmahagow.

Chairmen of Committees.

- | | |
|--------------------------------------|---|
| 1. <i>Argyll Naval Fund</i> | Major JOHN GILMOUR, M.P. |
| 2. <i>Finance, Chambers, and Law</i> | DAVID WILSON, D.Sc., of Carbeth. |
| 3. <i>Publications</i> | CHARLES DOUGLAS, D.Sc., of Auchlochan. |
| 4. <i>Shows</i> | C. H. SCOTT PLUMMER of Sunderland Hall. |
| 5. <i>Science</i> | DAVID WILSON, D.Sc., of Carbeth. |
| 6. <i>General Purposes</i> | CHARLES DOUGLAS, D.Sc., of Auchlochan. |
| 7. <i>Education</i> | ALEXANDER CROSS of Knockdon. |
| 8. <i>Forestry</i> | Sir ARCHIBALD BUCHAN HEPBURN, Bart. |

COMMITTEES—1915-1916.

1. ARGYLL NAVAL FUND.

Major JOHN GILMOUR, M.P., yr. of Montrave, Pollok Castle, Newton Mearns, *Convener*.

Sir ARCHIBALD BUCHAN HEPBURN of Smeaton, Bart., Prestonkirk.

Sir J. PATTEN MACDOUGALL, K.C.B., 39 Heriot Row, Edinburgh.

Sir KENNETH MACKENZIE of Gairloch, Bart., 10 Moray Place, Edinburgh.

JOHN MACLACHLAN of MacLachlan, Castle Lachlan, Strachur.

ALEXANDER CROSS of Knockdon, 19 Hope Street, Glasgow.

DAVID WILSON, D.Sc., of Carbeth, Killearn.

CHARLES DOUGLAS, D.Sc., of Auchlochan, Lesmahagow.

2. FINANCE, CHAMBERS, AND LAW.

DAVID WILSON, D.Sc., of Carbeth, Killearn, *Convener*.

ALEXANDER CROSS of Knockdon, 19 Hope Street, Glasgow, *Vice-Convener*.

JAS. I. DAVIDSON, Saughton Mains, Corstorphine.

JOHN M'HUTCHEN DOBBIE, Campend, Dalkeith.

DAVID FERRIE, Parbroath, Cupar-Fife.

Sir ARCHIBALD BUCHAN HEPBURN of Smeaton, Bart., Prestonkirk.

ROBERT MACMILLAN of Holm of Dalquhairn, Woodlea, Moniaive.

J. T. M'LAREN, The Leuchold, Dalmeny Park, Edinburgh.

JOHN M. MARTIN, 111 Elgin Crescent, Nottingham, London, W.

C. H. SCOTT PLUMMER of Sunderland Hall, Selkirk.

CHARLES DOUGLAS, D.Sc., of Auchlochan, Lesmahagow, *Chairman*,
ex officio.

WILLIAM HOME COOK, C.A., Auditor, *ex officio*.

3. PUBLICATIONS.

CHARLES DOUGLAS, D.Sc., of Auchlochan, Lesmahagow, *Convener*.

JOHN M'HUTCHEN DOBBIE, Campend, Dalkeith.

JAMES ELDER, Athelstanford Mains, Drem.

DAVID FERRIE, Parbroath, Cupar.

Sir ARCHIBALD BUCHAN HEPBURN of Smeaton, Bart., Prestonkirk.

ARTHUR B. NICOLSON of Glenbervie, Fordoun.

G. BERTRAM SHIELDS, Dolphingstone, Tranent.

Sir HUGH SHAW STEWART, Bart., of Greenock and Blackhall, Ardgowan,
Greenock.

R. D. THOM of Pitlochrie, Gateside.

DAVID WILSON, D.Sc., of Carbeth, Killearn.

ALEX. CROSS of Knockdon, Hon. Secretary, *ex officio*.

4. SHOWS.

C. H. SCOTT PLUMMER of Sunderland Hall, *Convener*.

JOHN M. MARTIN, 111 Elgin Crescent, Nottingham, London, W., } *Vice-*
H. M. LEADBETTER, Knowesouth, Jedburgh, } *Conveners*.

JAMES ALLISON, Clifton Mains, Ratho.

GEORGE BEAN, West Balloch, Montrose.

WALTER BIGGAR, Grange Farm, Dalbeattie.

WILLIAM CARRICK, The Baad, Stirling.

J. STEWART CLARK of Dundas Castle, South Queensferry.

GEORGE W. CONSTABLE, Traquair Estate Office, Innerleithen.

JAMES I. DAVIDSON, Saughton Mains, Corstorphine.
 JOHN M'HUTCHEN DOBBIE, Campend, Dalkeith.
 Sir HENRY DUNDAS, Bart., Polton House, Lasswade.
 LORD DUNGLASS, Springhill, Coldstream.
 THOMAS ELDER of Stevenson Mains, Haddington.
 WILLIAM ELLIOT, Lanark.
 Colonel G. J. FERGUSON-BUCHANAN of Auchentorlie, Bowling.
 DAVID FERRIE, Parbroath, Cupar-Fife.
 Brig.-General R. GORDON GILMOUR of Craigmillar, The Inch, Liberton.
 Sir ARCHIBALD BUCHAN HEPBURN of Smeaton, Bart., Prestonkirk.
 Right Hon. Sir ROBERT KEITH INCHES, Lord Provost of Edinburgh,
 2 Strathearn Road.
 J. ERNEST KERR of Harviestoun Castle, Dollar.
 ROBERT MACDIARMID, Corries, Lochawe.
 PETER MACINTYRE, Tighnablaire, Comrie.
 P. B. M'INTYRE, Mains of Findon, Conon Bridge.
 J. T. M'LAREN, The Leuchold, Dalmeny Park.
 ROBERT MACMILLAN of Holm of Dalquhairn, Woodlea, Moniaive.
 JAMES M'QUEEN of Crofts, Dalbeattie.
 HUGH MARTIN, Flowerdale, Kinrossie, Perth.
 WILLIAM MUNGALL of Transy, Dunfermline.
 WILLIAM POOLE, Englewood, Blackhall.
 A. AGNEW RALSTON, Philpstoun House, Philpstoun.
 JOHN C. ROBERTSON, Fodderty, Dingwall.
 G. BERTRAM SHIELDS, Dolphingstone, Tranent.
 JOHN P. SLEIGH, St John's Wells, Fyvie.
 SAMUEL STRANG STEEL of Philiphaugh, Selkirk.
 DUNCAN STEWART of Millhills, Crief.
 D. A. STEWART of Lochdhu, Nairn.
 Sir HUGH SHAW STEWART of Greenock and Blackhall, Bart., Ardgowan.
 ARCHIBALD WHYTE, Inverquharie, Kirriemuir.
 ROBERT C. YOUNG of Shoddesden, Netherfield, Johnstone.
 DAVID WILSON, D.Sc., of Carbeth, Killearn, Treasurer, *ex officio*.
 ALEX. CROSS of Knockdon, Hon. Secretary, *ex officio*.
 CHARLES DOUGLAS, D.Sc., of Auchlochan, Lesmahagow, Chairman, *ex officio*.
 Professor R. STANFIELD, 24 Mayfield Gardens, Edinburgh, Engineer, *ex officio*.

5. SCIENCE.

DAVID WILSON, D.Sc., of Carbeth, Killearn, *Convener*.
 , *Vice-Convener*.
 JOHN M'HUTCHEN DOBBIE, Campend, Dalkeith.
 CHARLES DOUGLAS, D.Sc., of Auchlochan, Lesmahagow.
 JAMES ELDER, Athelstaneford Mains, Drem.
 THOMAS ELDER of Stevenson Mains, Haddington.
 DAVID FERRIE, Parbroath, Cupar-Fife.
 W. STEUART FOTHERINGHAM, of Fotheringham and Murthly, Murthly.
 Sir ARCHIBALD BUCHAN HEPBURN of Smeaton, Bart., Prestonkirk.
 A. F. IRVINE of Drum, Drumoak.
 MURRAY LITTLE, Summerhill, Annan.
 WILLIAM MACDONALD, Strowan, Annfield Road, Inverness.
 J. T. M'LAREN, The Leuchold, Dalmeny Park.
 JOHN M. MARTIN, 111 Elgin Crescent, Nottinghill, London, W.
 ARTHUR B. NICOLSON of Glenbervie, Fordoun.
 C. H. SCOTT PLUMMER of Sunderland Hall, Selkirk.
 Sir HUGH SHAW STEWART, Bart., of Greenock and Blackhall, Ardgowan,
 Greenock.
 R. D. THOM of Pitlochrie, Gateside.
 ROBERT C. YOUNG of Shoddesden, Netherfield, Johnstone.
 ALEX. CROSS of Knockdon, Hon. Secretary, *ex officio*.
 J. F. TOCHER, Chemist, *ex officio*.
 A. N. M'ALPINE, Botanist, *ex officio*.
 R. S. MACDOUGALL, D.Sc., Zoologist, *ex officio*.

6. GENERAL PURPOSES.

CHARLES DOUGLAS, D.Sc., of Auchlochan, Lesmahagow, *Convener*.
 J. STEWART CLARK of Dundas Castle, South Queensferry.
 JOHN M'HUTCHEN DOBBIE, Campend, Dalkeith.
 Sir HENRY DUNDAS, Bart., Polton House, Lasswade.
 JAMES ELDER, Athelstaneford Mains, Drem.
 THOMAS ELDER of Stevenson Mains, Haddington.
 Sir ARCHIBALD BUCHAN HEPBURN of Smeaton, Bart., Prestonkirk.
 J. T. M'LAREN, The Leuchold, Dalmeny Park.
 ROBERT MACMILLAN of Holm of Dalquhairn, Woodlea, Moniaive.
 WILLIAM POOLE, Englewood, Blackhall.
 G. BERTRAM SHIELDS, Dolphingstone, Tranent.
 Sir HUGH SHAW STEWART, Bart., of Greenock and Blackhall, Ardgowan.
 DAVID WILSON, D.Sc., of Carbeth, Killearn, Treasurer, *ex officio*.
 ALEX. CROSS of Knockdon, Hon. Secretary, *ex officio*.

7. EDUCATION.

ALEXANDER CROSS of Knockdon, 19 Hope Street, Glasgow, *Convener*.
 CHARLES DOUGLAS, D.Sc., of Auchlochan, Lesmahagow.
 Sir ARCHIBALD BUCHAN HEPBURN of Smeaton, Bart., Prestonkirk.
 DAVID WILSON, D.Sc., of Carbeth, Killearn.
 JOHN STIRTON, *Secretary*.

8. FORESTRY.

Sir ARCHIBALD BUCHAN HEPBURN of Smeaton, Bart., Prestonkirk, *Convener*.
 A. H. ANDERSON, Kippendavio, Dunblane.
 JAMES I. DAVIDSON, Saughton Mains, Corstorphine.
 CHARLES DOUGLAS, D.Sc., of Auchlochan, Lesmahagow.
 LORD DUNGLASS, Springhill, Coldstream.
 Major JOHN GILMOUR, M.P., yr. of Montrave, Pollok Castle, Newton
 Mearns.
 DAVID KEIR, Ladywell, Dunkeld.
 LORD LOVAT, C.B., K.C.V.O., A.D.C., Beaufort Castle, Beaulieu.
 Right Hon. Sir HERBERT E. MAXWELL of Monreith, Bart., Whauphill.
 Sir HUGH SHAW STEWART, Bart., of Greenock and Blackhall, Ardgowan.
 Sir JOHN STIRLING MAXWELL of Pollok, Bart., Pollokshaws.
 JOHN MICHIE, M.V.O., Balmoral, Ballater.
 The MASTER of POLWARTH, Humble House, Upper Keith.
 Captain STIRLING of Keir, Dunblane.
 DAVID WILSON, D.Sc., of Carbeth, Killearn.

9. OFFICE-BEARERS.

Constitution : (1) The four Ordinary Directors for the district in which the Show for the year is to be held (with the exception of one retiring next year);
 (2) one Ordinary Director from each of the other Show districts; and
 (3) the Chairman of the Board, Hon. Secretary, and Treasurer, *ex officio*.

Aberdeen . { GEORGE BEAN, West Balloch, Montrose.
 { A. F. IRVINE of Drum, Drumoak.
 { JOHN P. SLEIGH, St John's Wells, Fyvie.
Glasgow . Sir HUGH SHAW STEWART, Bart., of Greenock and Blackhall,
 Ardgowan.
Perth . R. D. THOM of Pitlochrie, Gateside.
Stirling . PETER M'INTYRE, Tighnablaire, Comrie.
Edinburgh . G. BERTRAM SHIELDS, Dolphingstone, Tranent.
Dumfries . WALTER BIGGAR, Grange Farm, Dalbeattie.
Inverness . D. A. STEWART, Lochdhu, Nairn.
Border . GEORGE W. CONSTABLE, Traquair Estate Office, Innerleithen.

CHARLES DOUGLAS, D.Sc., of Auchlochan, Chairman, *ex officio*.
 ALEX. CROSS of Knockdon, Hon. Secretary, *ex officio*.
 Dr D. WILSON of Carbeth, Killearn, Treasurer, *ex officio*.

REPRESENTATIVES ON OTHER BODIES.**National Agricultural Examination Board.**

ALEX. CROSS of Knockdon, 19 Hope Street, Glasgow, Chairman.
 CHARLES DOUGLAS, D.Sc., of Auchlochan, Lesmahagow.
 Sir ARCHIBALD BUCHAN HEPBURN of Smeaton, Bart., Prestonkirk.
 DAVID WILSON, D.Sc., of Carbeth, Killearn.
 JOHN STIRTON, Highland and Agricultural Society.

Edinburgh and East of Scotland College of Agriculture.

D. FERRIE, Parbroath, Cupar-Fife.
 Sir ARCHD. BUCHAN HEPBURN of Smeaton, Bart., Prestonkirk.

West of Scotland Agricultural College.

Sir HUGH SHAW STEWART, Bart., of Ardgowan and Blackhall, Ardgowan,
 Greenock.
 JOHN M. MARTIN, 111 Elgin Crescent, Nottinghill, London, W.

Aberdeen and North of Scotland College of Agriculture.

WILLIAM DUTHIE, Tarves.
 Dr J. F. TOCHER, 41½ Union Street, Aberdeen.

Royal (Dick) Veterinary College.

JOHN M. MARTIN, 111 Elgin Crescent, Nottinghill, London, W.

Glasgow Veterinary College.

ALEX. CROSS of Knockdon, 19 Hope Street, Glasgow.

Scottish Milk Records Association.

ALEX. CROSS of Knockdon, 19 Hope Street, Glasgow.
 JOHN M'CAIG of Belmont, Stranraer.
 Sir HUGH SHAW STEWART, Bart., of Greenock and Blackhall.

MEETINGS.

General Meetings.—By the Charter the Society must hold two General Meetings each year, and, under ordinary circumstances, they are held in the months of January and June, in the Society's Hall, 3 George IV. Bridge, for the election of Members and other business. Twenty a quorum.

By a resolution of the General Meeting on 15th January 1879, a General Meeting of Members is held in the Showyard on the occasion of the Annual Show. This year no meeting will be held, on account of the decision of the Directors not to proceed with the Show.

With reference to motions at General Meetings, Bye-Law No. 10 provides—"That at General Meetings of the Society no motion or proposal

(except of mere form or courtesy) shall be submitted or entertained for immediate decision unless notice thereof has been given a week previously to the Board of Directors, without prejudice, however, to the competency of making such motion or proposal to the effect of its being remitted to the Directors for consideration, and thereafter being disposed of at a future General Meeting."

General Show at Edinburgh.—The following Resolution was adopted by the Board (1st December 1915): "That in the present circumstances no steps should be taken by the Directors towards holding a Show next year."

Directors' Meetings.—The Board of Directors meet (except when otherwise arranged) on the first Wednesday of each month from November till June inclusive, at half-past one o'clock P.M., and occasionally as business may require, on a requisition by three Directors to the Secretary, or on intimation by him. Seven a quorum.

Committee Meetings.—Meetings of the various Committees are held as required.

Nomination of Directors.—Meetings of Members, for the purpose of nominating Directors to represent the Show Divisions on the Board for the year 1917-1918, will be held at the places and on the days after mentioned:—

1. Edinburgh, Market Buildings, Gorgie, Wed., 31st Jan. 1917, at 2.
2. Glasgow, North British Railway Hotel, Wed., 14th Feb. 1917, at 1.
3. Stirling, Golden Lion Hotel, . . . Thur., 15th Feb. 1917, at 1.30.
4. Perth, Salutation Hotel, . . . Fri., 16th Feb. 1917, at 2.
- (In 1918 and 1919 the Meetings will be held in Cupar-Fife.)
5. Border District, Railway Hotel, St Boswells, . . . Thur., 1st Mar. 1917, at 1.
6. Aberdeen, Imperial Hotel, . . . Fri., 2nd Mar. 1917, at 2.30.
7. Inverness, Station Hotel, . . . Tues., 6th Mar. 1917, at 12.30.
8. Dumfries, King's Arms Hotel, . . . Wed., 14th Mar. 1917, at 1.

The nomination of Proprietor or other Members paying the higher subscription must be made in the 1st, 2nd, 4th, and 5th Districts; and the nomination of Tenant-Farmer or other Members paying the lower subscription, in the 3rd, 6th, 7th, and 8th Districts.

Retiring Directors are not eligible for re-election until after the lapse of at least one year.

EXAMINATIONS.

Agriculture.—The Examination for 1916 for the National Diploma in Agriculture will be held at the University, Leeds, on Monday, 20th March, and following days. Entries close on 1st March.

Dairy.—The Examination for 1916 for the National Diploma in Dairying will be held at the Dairy School, Kilmarnock, on Friday, 22nd September, and following days. Entries close on 15th August.

Forestry.—The Examination for the Society's Certificates in Forestry will be held at 3 George IV. Bridge, Edinburgh, in March 1917.

AGRICULTURAL EDUCATION

By a Supplementary Charter under the Great Seal, granted in 1856, the Society is empowered to grant Diplomas.

From 1858 to 1899 the Society held an annual Examination for Certificate and Diploma in Agriculture. In 1872 the Free Life Membership of the Society was granted to winners of the Diploma. In 1884 permission was given to holders of the Diploma to append the letters F.H.A.S. to their names.

In 1898 it was resolved by the Royal Agricultural Society of England and the Highland and Agricultural Society of Scotland to discontinue the independent Examinations in Agriculture held by the two Societies, and to institute in their stead a Joint-Examination for a NATIONAL DIPLOMA IN AGRICULTURE (N.D.A.) This Examination is now conducted under the management of the "National Agricultural Examination Board" appointed by the two Societies. In the year 1903, on the invitation of the two Societies, the Board of Agriculture and the Scotch Education Department agreed to appoint a representative from each to act on the Examination Board. Professor Middleton represents the former and Sir John Struthers, K.C.B., LL.D., the latter body.

REGULATIONS FOR EXAMINATION IN THE SCIENCE AND PRACTICE OF AGRICULTURE

REGULATIONS.

1. The Societies may hold conjointly, under the management of the National Agricultural Examination Board appointed by them, an Annual Examination in the Science and Practice of Agriculture, at a convenient centre.

2. Candidates who pass the Examination will receive the National Diploma in Agriculture—the Diploma to be distinguished shortly by the letters "N.D.A."

3. The Examination will be conducted by means of written papers and oral Examinations.

4. In order to be eligible to sit for the Board's Examination in Agriculture, a Candidate must—

(a) Present a certificate from a recognised Agricultural College that his attainments in the subjects of *General Botany, Geology, General Chemistry, Physics and Mechanics*, as attested by class and other examinations, are, in the opinion of the authorities of the College, such as to justify his admission to the Board's Examination ; or

(b) Produce evidence that he has passed the 1st B.Sc. or the Intermediate Examination in Science of a British University ; or

(c) Present a Senior Certificate obtained at the Local Examinations of the Universities of Oxford or Cambridge, and produce evidence that he has continued his study of science for at least a year, and has

obtained a certificate in subject 3 (a) Elementary Chemistry and Physics, (b) Botany of Group H of the Oxford Higher Local Examination, or in Subjects 1, Elementary Chemistry and Physics, and 4, Botany of Group E of the Cambridge Higher Local Examination ; or

(d) Present an Intermediate Leaving Certificate of the Scotch Education Department, and produce evidence that he has continued his studies for at least another year and has obtained the Higher Leaving Certificate in Science (including Chemistry and Botany).

5. In the case of students who satisfy the Board that they have not had the facilities for obtaining the foregoing certificates, the Board will be prepared to consider evidence of equivalent attainment.

6. Candidates will have the option of taking the whole of the following eight papers at one time, or of sitting for a group of any three or four in one year and the remaining group of four or five in the next year.

SUBJECT.	Maximum Marks.	Pass Marks.
1. Practical Agriculture (First Paper) . . .	300	180
2. Practical Agriculture (Second Paper) . . .	300	180
3. Farm and Estate Engineering—		
(a) Surveying	300	150
(b) Farm Buildings		
(c) Machinery and Implements		
4. Agricultural Chemistry	300	150
5. Agricultural Botany	300	150
6. Agricultural Book-keeping	200	100
7. Agricultural Zoology	200	100
8. Veterinary Science	200	100
	<u>2100</u>	<u>1110</u>

7. A Candidate who obtains not less than three-fourths (1575) of the aggregate maximum marks (2100) in the entire Examination will receive the Diploma with Honours, provided that he obtains not less than three-fourths (450) of the maximum marks (600) in the two Practical Agriculture papers.

8. Candidates electing to take the entire Examination at one time and failing in not more than two subjects may appear for these subjects in the following year. Failure in more than two subjects will be regarded as failure in the whole Examination.

9. Candidates electing to take the Examination papers in two groups and failing in a single subject may appear for that subject in the following year. Failure in more than one subject will be regarded as failure in the group.

10. Non-returnable fees must be paid by Candidates as follows :—

Entire Examination	Four guineas.
Group of Subjects	Two guineas.
One or two Subjects	One pound.

11. The Board reserve the right to postpone, abandon, or in any way, or at any time, modify an Examination, and also to decline at any stage to admit any particular Candidate to the Examination.

The Examination will take place at the Leeds University on MONDAY, MARCH 20, 1916, and days of the following week.

Forms of application for permission to sit at the Examination may be obtained from "The Secretary, Royal Agricultural Society of England, 16 Bedford Square, London, W.C.," or from "The Secretary, Highland and Agricultural Society of Scotland, 3 George IV. Bridge, Edinburgh," and must be returned duly filled up not later than WEDNESDAY, MARCH 1, 1916, when the Entries will close.

16 BEDFORD SQUARE, LONDON, W.C.,
December 1915.

SYLLABUS OF SUBJECTS OF EXAMINATION

PRACTICAL AGRICULTURE.

I.—FIRST PAPER.

1. *British Farming*.—Arable, stock-raising, dairying—Approximate areas covered by the different systems—Typical examples of each—Area in Great Britain under chief crops—Numbers of live stock—The recent history of agriculture—Short summary of agricultural returns.

2. *Climate*.—The effect of climate on farming practice—Rainfall—Temperature—Prevailing winds—Weather forecasts.

3. *Soils*.—The influence of geological formations on the systems of farming—Classification of soils—Character and composition—Suitability for cultivation—Reclamation—Drainage—Irrigation—Warping—Application of lime and marl—Bare fallows—Tillage—Subsoiling—Deep and thorough cultivation.

4. *Manures*.—The manures of the farm—The treatment of farmyard manure—The disposal of liquid manure and sewage—General manures—Special manures—Field trials of manures—The application of manures—Period of application and amounts used per acre—Unexhausted value of manures and feeding-stuffs.

5. *Crops*.—Wheat, barley, oats, rye, beans, peas, potatoes, turnips, swedes, mangolds, forage plants, hops, and other crops—Their adaptation to different soils and climates—Varieties—Selection of seed—Judging seeds—Cultivation, weeds and parasitic plants, best methods of prevention and eradication—Harvesting—Storing—Cost of production—Improvement of crops by selection and hybridising—Field trials—Methods which the farmer may adopt—Selection to resist disease—The principles of rotations—Rotations suitable for different soils and climates—Rotations and the maintenance of fertility—Green manuring—Leguminous crops in rotation—Catch crops—The advantages and disadvantages of rotations—Specialised farming.

II.—SECOND PAPER.

6. *Live Stock*.—The different breeds of British live stock—Their origin, characteristics, and comparative merits—Suitability for different districts—Breeding—General principles—Selection—Mating—Crossing—Rearing and general management—Breeding and rearing of horses, cattle, sheep, pigs and poultry—Rearing colts and raising store stock—The foods of the farm—Their composition and suitability for different classes of stock—Purchased foods—Composition and special value—Rations for different kinds and ages of stock—Cost of producing beef, mutton, pork, and milk—Cost of feeding farm horses.

7. *The disposal of Crop, Produce, and Stock.*—Marketing grain and other crops—Sale of stock—Live weight—Dead weight.

8. *Milk.*—The production and treatment of milk—The manufacture of cheese, butter, &c.—The utilisation of by-products.

9. *Farming Capital.*—Calculations of the stocking and working of arable, stock, and dairy farms—Labour on the farm—Farm valuations—Rent and taxes.

10. *Renting a Farm.*—Indications of condition, productive power, and stock-carrying capacity—Leases—Conditions of occupancy.

N.B.—*It is essential that a Candidate know his subject practically, and that he satisfy the Examiner of his familiarity with farm routine.*

III.—FARM AND ESTATE ENGINEERING.

SURVEYING.

1. The use and adjustment of instruments employed in Surveying and Levelling.

2. Land surveying by chain—Plotting from field book, and determination of areas surveyed—The simpler "field problems."

3. Levelling and plotting from field book.

4. A sufficient knowledge of Trigonometrical Surveying for the determination of heights and distances by Theodolite.

5. A knowledge of the various classes of maps published by the Ordnance Survey Department and their Scales.

FARM BUILDINGS.

6. *Roads, Fences, and Land Drainage.*—The construction and maintenance of farm roads, fences, and ditches—Drains, and cost.

7. *Buildings.*—Buildings required on different classes of farms—Economical arrangement of farm buildings—Materials—Construction—Ventilation—Drainage—Water supply—Dimensions of dairy, stables, cow-sheds, yard, courts, and piggeries—Accommodation for power—Implement, machinery, and cart sheds—Hay and grain sheds—Shelter sheds—Storage of manure—Approximate cost of farm buildings for sizes of farms and system of farming.

MACHINERY AND IMPLEMENTS.

8. *Power.*—The principle of action, construction, and method of working of steam, gas, and oil engines, petrol motors, and boilers—Estimation of the brake horse-power of engines—Care and management of engines and boilers—Power derived from water—Measurement of the quantity of water flowing in a stream—Water wheels—Turbines—Pumps, principle of action and construction—Flow of water through pipes—Windmills—Cost and working expenses in connection with the above.

9. *Agricultural Machinery.*—The mode of action and the general principles involved in the construction and working of farm implements and machinery—Pulleys and belting—Power transmitted by belts—Toothed gearing—Shafting and bearings—Lifting appliances—Strength and care of chains—Lubrication—Construction of simple concrete foundations for engines and machines.

10. *Implements of Harvesting.*—Reaping machines—Mowing machines—Rakes—Teddies—Sweeps—Elevators—Potato raisers.

11. *Implements of Transit.*—Carts, waggons, rick lifters, traction engines, motors.

12. *Threshing and Food-preparing Machinery.*—Threshing machines, screens, winnowers—Hummelers, chaff cutters—Pulpers—Cake breakers.

13. *Dairy Appliances.*—Milking machines—Cream separators—Churns and other butter-working appliances—Milk delivery cans—Cheese-making utensils—Vats and presses.

N.B.—*Each Candidate should have with him at the Examination a pair of compasses, scales of equal parts, including a scale of one chain to an inch, and the scale fitting the Ordnance map, $\frac{1}{2500}$ or 25'344 inches to the mile, a small protractor, a set square, and a straight-edge about 18 inches in length.*

Candidates are expected to have had some experience with agricultural machinery and implements under actual working conditions, and to be capable of illustrating their answers, when necessary, by intelligible sketches or diagrams.

IV.—AGRICULTURAL CHEMISTRY.

1. *The Atmosphere.*—Its composition and relations to plant and animal life.

2. *Water.*—Rain water—Soil water and drainage—Drinking water—Sewage and irrigation.

3. *The Soil.*—Origin, formation, and classification of soils—Sampling—Analysis—Composition of soils—The chemical and physical properties of soils—The water and air of the soil—Biological changes in the soil—The soil in relation to plant growth—Fertility—Causes of infertility—Improvement of soils.

4. *Manures.*—Theories of manuring—Classification of manures—Origin, nature, and characteristics of manures—Manufacture of manures—Composition, analysis, adulteration, and valuation of manures—Farmyard manure and other natural manures—Green-manuring—Liming, marling, claying—Artificial manures, their origin and manufacture—Fertilisers and Feeding Stuffs Act—Sampling of manures.

5. *Poisons, Antiseptics, and Preservatives.*—General chemical composition and character of insecticides, fungicides, antiseptics, and preservatives used on the farm.

6. *Plants and Crops.*—Constituents of plants—Assimilation and nutrition of plants—Sources of the nitrogen and other constituents of plants—Germination—Action of enzymes—Composition and manurial requirements of farm crops—Food products derived from crops—Manuring experiments.

7. *Animals.*—Composition of animal body—Animal nutrition—Digestion—Assimilation, metabolism, respiration, and excretion.

8. *Foods and Feeding.*—Constituents of foods—Origin, nature, and composition of chief feeding-stuffs—Sampling, analysis, and adulteration of foods—Nutritive value and digestibility of food—Functions of chief food constituents—Energy values—Relation of foods to the production of work, meat, milk, and manure—Manurial residues of foods.

9. *Dairy Chemistry.*—The composition of milk, cream, butter, cheese, &c.—Conditions which influence the composition of milk and milk products—Action of ferments and enzymes on milk and milk products—Milk-testing—Analysis and adulteration of dairy products.

N.B.—*Candidates are required to bring their Laboratory Notes to the Oral Examination in this subject.*

V.—AGRICULTURAL BOTANY.

In addition to a general knowledge of the morphology, histology, and physiology of plants, candidates will be expected to possess a detailed knowledge of the following subjects:—

British grasses of agricultural importance: recognition of at any stage of growth. Habitats of important species. Constitution of the grass flora of good meadows and pastures. Composition of seed mixtures for temporary and permanent leys on various soils. The effects of artificial manures on the flora of grass land.

The weeds of arable and grass land. Poisonous and parasitic weeds. Methods of distribution by seed and vegetatively: of eradication. Weeds as soil indicators. Recognition of the seeds of the common weeds, particularly those characteristically found in clover, grass, &c., seed.

The chief varieties of wheat, barley, oats, clovers, roots, and other farm crops: their suitability for various climatic and soil conditions. The identification of the more important types of cereals by means of their grain characters. Characteristics of good and bad samples of cereals.

Materials used in feeding-cakes and meals: identification of.

Grafting, pruning, and the management of orchards.

Plant-breeding. Principles of heredity in plants. Pure lines. Fluctuating variability. Selection.

Disease in plants. Diseases due to the attacks of parasitic fungi. Resistance to disease: conditions affecting. The life-history of the more important species of *Plasmodiophora*, *Synchytrium*, *Phytophthora*, *Peronospora*, *Sphaerotheca*, *Nectria*, *Claviceps*, *Sclerotinia*, *Ustilago*, *Tilletia*, *Puccinia*, *Polyporus*, *Armillaria*, and of any fungoid diseases scheduled from time to time by the Board of Agriculture and Fisheries.

Yeasts and fermentation.

The general outlines of bacteriology: nitrogen fixation, nitrification, and denitrification. Putrefaction and the bacteriology of milk, butter, and cheese.

VI.—AGRICULTURAL BOOK-KEEPING.

Principles of book-keeping; single and double entry; opening books, description of subsidiary books, with examples of entries therein; the ledger; posting; preparation of trial balance; valuation of stocks and effects; closing and proving the books, preparation of profit and loss account and balance-sheet; ruling off accounts.

Application of special methods to farms of varying requirements.

VII.—AGRICULTURAL ZOOLOGY.

1. The part played by common animals in helping or hindering agricultural operations, as illustrated by moles and voles, insectivorous and other birds, snails and slugs, useful and injurious insects, arachnids and myriapods, earthworms, &c.

2. *General Structure of Insects*, especially the external characters.

3. *Life-history of Insects*.—Economic importance of different stages. A knowledge of the life-history of the principal insect pests as affording a basis for appropriate treatment.

4. *Classification of Insects*.—The general characters of the following Natural Orders: Coleoptera, Lepidoptera, Hymenoptera, Diptera, Hemiptera, Orthoptera, Neuroptera.

5. *Acarina* injurious to Food Crops and Live Stock.
6. *Parasitic Worms*.—Flukes, Tapeworms, and Threadworms.
7. *Preventive and Remedial measures* in regard to insects, acarines, and worm Parasites—*e.g.*, farm practice in relation to the discouragement of Insect Attack. Encouragement of insect-eating birds and mammals. Artificial remedies. Insecticides. Treatment for Parasites.

N.B.—*Practical acquaintance with common animals, especially insects and worm parasites, will be expected. Where the Candidate is not acquainted with the scientific name of an animal, the generally received English name will be accepted. Candidates are required to bring their Laboratory Notes to the Oral Examination in this subject.*

VIII.—VETERINARY SCIENCE.

1. Elementary Anatomy and Physiology of the horse, ox, sheep, and pig.
2. The general principles of breeding—including the physiology of reproduction, the laws of heredity, the periods of gestation, and the signs of pregnancy in the mare, cow, ewe, and sow.
3. Dentition as a means of determining the age of horses, cattle, sheep, and swine.
4. The management of farm stock in health and disease.

The following won the Diploma in 1915 :—

Diploma with Honours.

1. JOHN WILSON, West of Scotland Agricultural College, Glasgow.
2. JAMES KER BELL, Edinburgh and East of Scotland College of Agriculture, Edinburgh.
3. JOHN CURRIE HOWIE, West of Scotland Agricultural College, Glasgow.

Diploma.

- RICHARD BRETHERTON, Harris Institute, Preston.
 GEORGE DUNCAN BROWN, University of Leeds.
 WILLIAM A. C. CARR, Marischal College, Aberdeen.
 STEPHEN M. CHERRIE, West of Scotland Agricultural College, Glasgow.
 WILLIAM CROMIE, Royal College of Science, Dublin.
 PAUL ALEXANDER EXLEY, University of Leeds.
 JAMES BUTLER GODDARD, Harris Institute, Preston.
 NORMAN S. GRIEVE, Aberdeen and North of Scotland College of Agriculture, Aberdeen.
 FRANK LESLIE HALL, Harper-Adams Agricultural College, Newport, Salop.
 MISS ANNIE JANE HASTINGS, West of Scotland Agricultural College, Glasgow.
 ALEXANDER HAY, Edinburgh and East of Scotland College of Agriculture, Edinburgh.
 FREDERIC WESTLEY IVENS, Harper-Adams Agricultural College, Newport, Salop.
 EVAN THOMAS JONES, University College of Wales, Aberystwyth.
 VIVIAN GEORGE JONES, Harper-Adams Agricultural College, Newport, Salop.
 JOHN ARCHIBALD MACARTHUR, West of Scotland Agricultural College, Glasgow.
 ANDREW M'BRIDE, West of Scotland Agricultural College, Glasgow.
 JAMES M'LINDEN, West of Scotland Agricultural College, Glasgow.
 THOMAS DUNCAN MOSSCROP, South-Eastern Agricultural College, Wye, Kent.

GEORGE PARK, Harris Institute, Preston.
BHAILAL S. PATEL, West of Scotland Agricultural College, Glasgow.
ALAN STEWART PATTEN, Royal Agricultural College, Cirencester.
HAMO NEWTON PERCIVAL, Harris Institute, Preston.
JOHN CYRIL PINDAR, Midland Agricultural and Dairy College, Kingston,
Derby.
CHARLES EDWARD PLATT, Holmes Chapel Agricultural College, Cheshire.
HENRY ROEBUCK, University of Leeds.
GEORGE EDWARD ROBERTS, University of Leeds.
CLIFFORD WILLIAM ROWELL, Agricultural College, Uckfield, Sussex.
HERBERT RAY STEWART, Royal College of Science, Dublin.
ROY BURCH STRANG, South-Eastern Agricultural College, Wye, Kent.
ALEXANDER JOHN WATT, Aberdeen University.
JOHN BARTON WHALLEY, Harris Institute, Preston.
DAVID WYLLIE, West of Scotland Agricultural College, Glasgow.
HUGH MAIR YOUNG, West of Scotland Agricultural College, Glasgow.

EXAMINATION PAPERS OF PAST YEARS.

Copies of the Papers set at the Annual Examinations for the National Diploma in the Science and Practice of Agriculture, held from 1905 to 1916, may, so far as available, be had upon application. Price 6d. per set.

VETERINARY DEPARTMENT

The Society established a Veterinary Department in 1823, but by an arrangement made with the Royal College of Veterinary Surgeons, the Society's examination ceased in 1881. Holders of the Society's Veterinary Certificate are entitled to become Members of the Royal College of Veterinary Surgeons on payment of certain fees, without being required to undergo any further examination. The number of Students who passed for the Society's Certificate is 1183.

The Society votes annually eleven silver medals for Class Competition to each of the two Veterinary Colleges in Scotland, the one in Edinburgh and the other in Glasgow.

FORESTRY DEPARTMENT

THE Society grants FIRST and SECOND CLASS CERTIFICATES in FORESTRY.

1. An Examination will be held each alternate year about the month of April.

2. Next Examination will be held in the year 1917.

3. Candidates must possess—1. A thorough acquaintance with the theory and practice of Forestry. 2. A general knowledge of the following branches of study, so far as these apply to Forestry: (a) The Elements of Botany and Forest Zoology; (b) The Elements of Physics, Chemistry, and Meteorology; (c) Forest Engineering, including Land and Timber Measuring and Surveying; Mechanics and Construction, as applied to fencing, draining, bridging, road-making, and saw-mills; and Implements of Forestry; (d) Book-keeping and Accounts.

4. The examinations are open to candidates of any age, may be both written and oral, and will include such practical tests as may from time to time be decided to apply.

5. The maximum number of marks for each subject is 100; Pass marks for First-Class Certificate—Forestry, 75; all other subjects, 60. Pass marks for Second-Class Certificate—Forestry, 60; all other subjects, 50.

6. A Candidate who obtains Pass marks in certain subjects, but fails in others, may come up for these other subjects alone, it being understood that without the special permission of the Society no Candidate will be eligible to enter for more than two subsequent examinations.

7. A Candidate who has obtained the Second-Class Certificate may enter again for the First-Class Certificate.

The list of students who obtained certificates prior to 1899 appears in the 'Transactions,' Fifth Series, vol. xi. (1899).

The following have since obtained First-Class Certificates:—

ERIC ARTHUR NOBBS, Department of Agriculture, Cape Town, .	1899
GEORGE POTTS, Grey College, Bloemfontein, Orange River Colony, .	1899
DUNCAN S. RABAGLIATI, 1 St Paul's Road, Bradford, .	1901
FRANK SCOTT, Dumfries House Mains, Cumnock, .	1903
WILLIAM T. STOCKLEY, Rose Villa, Garswood, near Wigan, .	1906
A. FRANK WILSON, C.D.A. (Edin.), Reeddieleys, Auchtermuchty, .	1907
GEORGE FISHER, Farm Brook, Pilling, Garstang, Lancs., .	1909
JOHN PATTEN, jun., Hulne Park, Alnwick, .	1909
ALEXANDER MITCHELL, Dalmeny Park, Edinburgh, .	1909
JOHN D. DAVIDSON, Brimstage, Birkenhead, .	1911
DONALD DOULL, M.A., A.R.C.Sc., High School, Kelso, .	1911
JAMES W. MACKAY, Jervaulx Abbey, Middleham, Yorks., .	1915
HARRY WATSON, Darnaway, Forres	1915

The following have since obtained Second-Class Certificates :—

WILLIAM BRUCE, B.Sc., East of Scotland College of Agriculture, Edinburgh,	1901
RAJAPPIER SWAMINATHAN, 56 Jesus Lane, Cambridge,	1901
THOMAS USHER, Courthill, Hawick,	1901
ALLAN CARRUTH, Lawmarnock, Kilbarchan,	1905
ALEX. M. LUMSDEN, Newburn Schoolhouse, Upper Largo,	1905
ROBERT M. WILSON, Laws Cottage, Duns,	1905
THOMAS CAMPBELL, Greystoke, Penrith,	1906
DONALD FERGUSON, Quarry Lane, Lennoxtown,	1906
CHARLES PENRHYN ACKERS, Huntly Manor, Gloucester,	1908
ROBERT HOWIE, Beechwood, Arbroath,	1908
JOHN TROTTER, D.Sc., 22 West Saville Terrace, Edinburgh,	1908
JAMES A. S. WATSON, Downieken, Dundee,	1908
NORMAN H. PEARSON, 52 Percy Park, Tynemouth,	1909
LIONEL F. STOBART, Royal Agricultural College, Cirencester,	1911
ALEXANDER GEORGE NORRIE, Cairnhill, by Turriff,	1913
WILLIAM WATT, Darnaway, Forres,	1913
WILLIAM P. GREENFIELD, 6 Littlefield Lane, Grimsby	1915

SYLLABUS OF EXAMINATION

I.—SCIENCE OF FORESTRY AND PRACTICAL MANAGEMENT OF WOODS.

I. *Principles of Scientific Forestry*.—1. Effects of heat, light, moisture, and air-currents on forest vegetation. 2. Effects of depth, porosity, moisture, and chemical composition of the soil on forest vegetation. 3. Effects of forest vegetation on the soil and air. 4. Rate and extent of development, longevity, and reproductive power of trees. 5. Pure and mixed woods. 6. Systems of silviculture.

II. *Forest Organisation*.—7. General ideas regarding a regulated system of forest management. 8. Knowledge of working plans of forests.

III. *Practical Management of Woods*.—9. Draining and irrigation. 10. Choice of species for various situations. 11. Seed and sowing, including nurseries. 12. Planting. 13. Natural regeneration by seed, shoots, and suckers. 14. Formation of mixed woods. 15. Tending of young woods. 16. Pruning. 17. Thinning. 18. Silvicultural characteristics of the principal trees.

IV. *Injuries by Storms and Fires*.—19. Storms. 20. Fires.

V. *Timber*.—21. Its technical properties. 22. Its defects. 23. Recognition of different kinds of timber. 24. Processes for increasing its durability.

VI. *Utilisation of Produce*.—25. Uses of wood and other produce. 26. Felling. 27. Conversion. 28. Seasoning. 29. Transport. 30. Sales. 31. Harvesting of bark.

II.—FOREST BOTANY AND FOREST ZOOLOGY.

(a) FOREST BOTANY.

The fundamental facts of morphology, physiology, and classification of plants. The structure and function of the plant-cell and the plant-tissues. Their primary distribution. The secondary changes they exhibit in consequence of perennation.

The structure and function of the root and shoot in flowering-plants. Buds, their forms and uses. The flower. The fruit. The seed.

The structure and function of vegetative and reproductive organs of fungi.

Relationship of plants to air, soil, and water. Effect of light, heat, and mechanical agencies upon plants. Nutrition. The nature and elements of the food of plants. Sources of plant-food. The absorption, elaboration, transference, and storage of food. Respiration and transpiration. Parasites and saprophytes. Symbiosis.

Growth of plants in length and thickness. Correlation of growth, pruning. Germination of seeds. Formation of wood and bark. Healing of wounds.

Diseases of plants due to faulty nutrition and unfavourable circumstances of growth. Diseases due to attacks of fungi.

Natural reproduction and propagation by seeds and by buds. Fertilisation of flowers. Hybridisation. Artificial propagation by budding, grafting, layering, and cutting.

The characters of the large groups and classes of the vegetable kingdom. The characters of the families of plants which include the chief timber trees. The botanical characteristics of the principal British forest-trees (including the structural features of their wood). The weeds of the forest and their significance.

(b) FOREST ZOOLOGY.

The group Insecta: its position in the animal kingdom. Structure, mode of reproduction, and metamorphosis of insects. The outlines of classification of the group. Conditions favourable to the numerical increase of insects. Natural checks to increase (*e.g.*, birds, mammals, parasitic insects). The identification and life-history of the more important insects injurious to forest-trees and fruit-trees. The damage caused by these insect pests and their mode of attack. The damage caused by animals. Preventive and remedial measures.

III.—PHYSICS, CHEMISTRY, AND METEOROLOGY.

Physics.

Mass, weight, specific gravity, solid, liquid, and gaseous states of matter. Capillarity, osmose, vapour tension, suction pump, force pump, syphon, barometer, atmospheric pressure. Boyle's law. Levers and pulleys. Heat, measurement of heat, specific heat; transference of heat by conduction, convection, and radiation. Boiling and freezing. Latent heat. The thermometer. The conservation and transformation of energy. Light—reflection, refraction, polarisation; the spectrum. The rudiments of electricity and magnetism.

Chemistry.

Elements. Oxygen, hydrogen, nitrogen,—their preparation, properties, and chief compounds. Acids, bases, salts. Combustion, oxidation, reduction. Sulphur, carbon, phosphorus; and their compounds, with oxygen and hydrogen. Metals—potassium, sodium, calcium, magnesium, aluminium, iron, copper, lead, mercury, and their chief compounds. Carbohydrates, marsh gas, olefiant gas, alcohol, acetic acid, oxalic acid. Distillation of wood and coal.

Meteorology.

The atmosphere, its composition and physical properties. Measurement of pressure and temperature. The barometer. Rain, hail, snow, fog, cloud, dew, the dew-point, hoar frost. The weathering of rocks and soils. Gases injurious to vegetation.

IV.—FOREST ENGINEERING, INCLUDING LAND AND TIMBER MEASURING AND SURVEYING; MECHANICS AND CONSTRUCTION AS APPLIED TO FENCING, BRIDGING, ROAD-MAKING, AND SAW-MILLS.

1. The use of the level and measuring-chain. Measuring and mapping surface areas. 2. The measurement of solid bodies—as timber, stacked bark, fagots, &c., earthwork. 3. The different modes of fencing and enclosing plantations; their relative advantages, durability, cost of construction, and repairs. 4. The setting out and formation of roads for temporary or permanent use. 5. The construction of bridges over streams and gullies; of gates or other entrances. 6. The construction and working of estate saw-mills.

V.—ARITHMETIC—BOOK-KEEPING.

1. Arithmetic—including Practice, Proportion, and Decimal Fractions. 2. Book-keeping—including the description of books to be kept, and the solution of practical questions in Book-keeping and the preparation of Accounts.

EXAMINATION PAPERS, 1915

PRACTICAL FORESTRY.

1. A wood extending to 300 acres, 60 years old, and composed of $\frac{1}{2}$ Larch and $\frac{1}{2}$ Spruce in groups, has had the Larch badly damaged by wind making large openings due to some extent to general over-density. It being undesirable to clear-fell the whole area at once, (a) how would you recommend treating it to make the most of it commercially and restock the ground within 12 years? (b) State your reasons for your proposals.

2. Supposing you have a property with 1000 acres of existing coniferous woodland, and it is decided to increase the woodland area to 3000 acres, utilising the timber to accomplish this. Give in detail your method of preparing a working plan for the whole area (on a 70 years' rotation). The existing woodlands comprise 600 acres varying from 10 to 25 years old and 400 acres of timber 60 to 70 years old, all of which is in good order and well stocked.

3. In carrying out the plan prepared in (2) you have to prepare a nursery—1 acre being ready for immediate use. Describe your method and the work for the first 4 years, and how many plants of each species are required to be raised or purchased annually, one-third of the ground being suitable for Larch, one-third for Spruce, and one-ninth each for Douglas, Scots pine, and Silver fir. State if you would recommend introducing other species, and how and why you propose to do so.

4. Describe the nature of the work to be carried out in the first 20 years as proposed in (2), treating it in four groups or periods of five years in a general way and the work in each of the first three years in detail.

5. (a) What is meant by the term satisfactory degree of density?
- (b) What effect has over-density (1) on the trees individually, (2) on the wood in general?
- (c) What results from understocking (1) to the soil, (2) the individual tree, (3) the quality of timber, (4) financially?
- (d) What would you do to assist the Oak in an Oak and Beech wood of 25 years old in which the latter is threatening to suppress the former?
6. (a) Describe how you would proceed in valuing, for disposal, a growing crop of timber.
- (b) Compare the qualities of Larch, Scots pine, and Spruce timbers, and enumerate the chief commercial uses of each.
- (c) Enumerate the chief commercial uses of Oak, Ash, Elm, Beech, and Birch.

(Three hours allowed.)

FOREST BOTANY AND FOREST ZOOLOGY.

(A) FOREST BOTANY.

(Four questions only to be attempted.)

1. Describe and compare the flowers and fruit of the following trees :—
Salix, Populus, Corylus, Carpinus, Betula, Alnus, Fagus, Castanea, Quercus.
2. Give a description of any fungus injurious to Pine or Spruce under the heads—
(a) How recognised ;
(b) Life-history ;
(c) Treatment.
3. In what various ways are forest trees affected by light ?
4. Compare in general structure the stem of an Angiosperm and a Gymnosperm.
5. Give an account of the absorption and circulation of water in a tree.

(B) FOREST ZOOLOGY.

(Two questions only to be attempted.)

1. By means of drawings illustrate the various types of galleries met with in the wood and bark beetles (Scolytidae).
2. What are the four most troublesome insects of your district ? Describe in detail any one of them.
3. What are the general characters of the membrane-winged insects (Hymenoptera) ? Make a list of those of forest importance and add a note on each.

(Two hours allowed.)

PHYSICS, CHEMISTRY, AND METEOROLOGY.

1. Explain the meaning of the terms "acids, bases, and salts." Describe the properties of each class, and give examples from substances containing calcium and phosphorus.

2. Describe how the destructive distillation of wood may be carried out. State briefly what you know of the composition and value of the distillate. Compare the volatile products with those obtained from the destructive distillation of coal.

3. What is meant by atmospheric pressure, and how would you determine it? Is atmospheric pressure constant, and if not, what are the chief causes of its variation in any locality?

4. What do you understand by the term "element"? Name the chief properties of elements, classifying into groups those with like properties.

5. Name the chief factors which operate in bringing about the reduction of rocks to soil. Describe separately the mechanical and chemical agencies, and give an example of the operation of each in the process of weathering.

(An hour and a half allowed.)

FOREST ENGINEERING.

1. The following notes from a Field Book refer to measurements taken for the purpose of estimating the quantity of earth to be excavated in connection with the construction of a road.

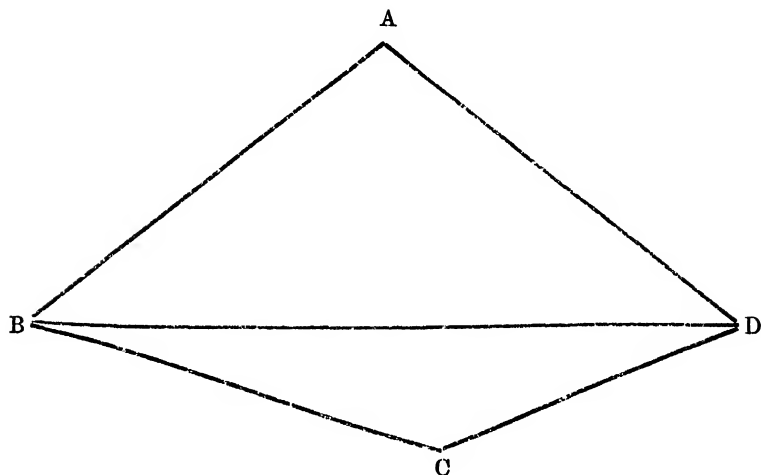
One side is vertical, and the opposite side has a slope of $1\frac{1}{2}$ to 1. The width at the bottom is 18 feet, and the total length is 210 feet, which may be assumed to be divided into three equal parts, and the measurements made at the middle of each part.

Make a dimensioned sketch of each section, and calculate the total amount of earth to be excavated in cubic yards.

Rise.	B.S.	I.S.	F.S.	Fall.	Reduced Level.	Remarks.
	12.86	8.26 6.59	5.85		O.	1st Section.
	10.96	7.03 6.99	6.72		O.	2nd Section.
	8.90	6.84 7.05	6.26		O.	3rd Section.

2. Draw the plan of a field from the following notes to a scale of 1 chain to the inch, and find the area of the field (see fig. 1).

Fig. 1.



Also measure the length of the perpendicular from A to BD.

Links.
⊙ D
820
630
0 500
45 390
30 250
⊙ A

	⊙ A
	760
42	450
25	310
	⊙ B

⊙ D
5 40
⊙ C
⊙ C
610
⊙ B
⊙ B
1050
⊙ D

3. Make up the following Level Book. Plot the section to a horizontal scale of 1 inch to 1 chain and a vertical of 1 inch to 10 feet.

Rise.	B.S.	I.S.	F.S.	Fall.	Reduced Level.	Distance Links.	Remarks.
	1.52				30		B.M.
	7.48		8.62			0	O A
		10.71				120	
	5.91		13.56			250	
		8.65				340	
	9.44		6.37			480	
		8.13				580	
		6.28				680	
	8.38		4.19			800	
		5.41				930	
		3.25				1050	
	6.65		0.73			1200	
		8.29				1360	
			11.53			1550	O B

4. Describe, with the aid of diagrams, how you would proceed in the field in order to find the height of an object :—

(a) The base of which you can approach.

(b) The base of which is inaccessible.

5. Give dimensioned sketches, showing in cross-section a macadamised road :—

(a) On a bank.

(b) In a cutting.

(c) On the side of a hill having a steep sidelong slope.

How would you provide for drainage?

6. Describe and sketch the general arrangement of a portable saw-milling plant.

How is the timber brought to, and taken from, the saw?

ARITHMETIC AND BOOK-KEEPING.

I. ARITHMETIC.

1. A piece of timber is 19 feet 6 inches long, 16 inches broad, and $10\frac{1}{2}$ inches deep. Its cost is £2, 11s. 6d. Find the cost per cubic foot, stating the pence to three places of decimals.

2. Find by practice the value of 211 tons 11 cwt. 37 lb. @ 9s. 4d. per cwt.

3. A purchases a quantity of timber and sells it to B at a profit of 8 per cent. B sells the same timber to C at a profit of 10 per cent. What profit per cent would A have made if he had sold the timber direct to C at a price the latter paid to B? State your answer in decimals.

4. A rectangular piece of ground 200 yards long and 80 yards broad is to be planted with young trees. The trees are to be 12 feet apart, and there is to be a space of 6 feet between the outermost trees and the boundaries. How many trees are required?

II. BOOK-KEEPING.

You are the forester on the estate of Craigbeck. At 1st June 1914 the balance in bank was £53, while the cash on hand was £7, and there was a sum of £159 due to the estate by Alexander Black. The following are your transactions during the month of June 1914:—

1914.

- June 1. Sold to Alexander Black on credit 1000 larch trees @ 8s. 6d.
 " 2. Paid cash for carriage, to be recovered from Alexander Black, £5.
 " 4. Sent cheque to Peter Jones in settlement of his account of £40 for implements, less discount at 5 per cent.
 " 7. Received rent of cottage, £8 in cash.
 " 9. Purchased from Alexander Black a brown horse the price of which, £40, it is arranged shall be set against his account.
 " 11. Received from auctioneer and paid into bank cheque p. £155, being net proceeds of sales by him.
 " 15. Received and paid into bank Alexander Black's cheque in settlement of his account to date, allowing him £5 discount.
 " 18. Sent to proprietor cheque p. £250.
 " 23. Paid for young trees by cheque, £18.
 " 30. Drew from bank £20.

Paid salary and wages, £17.

- (1) Write up Alexander Black's account in the Ledger.
 (2) Write up the cash book, keeping separate columns for bank, cash, and discount, and showing the balances in bank and on hand at 30th June.

(One hour and a half allowed.)

DAIRY DEPARTMENT

EXAMINATION IN THE SCIENCE AND PRACTICE OF DAIRYING

This Examination, instituted in 1897, is conducted by the National Agricultural Examination Board, appointed jointly by the Royal Agricultural Society of England and the Highland and Agricultural Society of Scotland.

REGULATIONS.

1. The Societies may hold annually in England and in Scotland, under the management of the National Agricultural Examination Board appointed by them, one or more Examinations for the National Diploma in the Science and Practice of Dairying; the Diploma to be distinguished shortly by the letters "N.D.D."

2. The Examinations will be held on dates and at places from time to time appointed and duly announced.

3. A non-returnable fee of *Two Guineas* will be required from each candidate.

4. Forms of Entry for the Examination in England may be obtained from "The Secretary, Royal Agricultural Society of England, 16 Bedford Square, London, W.C.," and must be returned to him duly filled up, with the entry-fee of £2, 2s. on or before August 15th.

5. Forms of Entry for the Examination in Scotland may be obtained from "The Secretary, Highland and Agricultural Society of Scotland, 3 George IV. Bridge, Edinburgh," and must be returned to him duly filled up, with the entry-fee of £2, 2s. on or before August 15th.

6. A candidate may enter for the Examination either in England or Scotland, but not in both; and a candidate who has once taken part in an Examination in England cannot enter for an Examination in Scotland, or *vice versa*.

7. As a preliminary to the acceptance of an application for permission to enter for the Examination, a candidate must produce:—

(1) A certificate testifying that he or she has received at least SIX session months instruction (not necessarily continuous) in practical dairy work at an approved Dairy training institution.

(2) Evidence that he or she has spent at least FOUR¹ months on an approved Dairy farm, and that he or she has taken part in the work.

(3) Certificates in a prescribed form, from a recognised institution (or recognised institutions) showing that he or she has attended approved courses in Chemistry, Bacteriology, and Botany, and has satisfied the authorities of the institution of his (or her) fitness for admission to the Examination.

8. In the Examination a candidate will be required to satisfy the Examiners, by means of written papers, practical work, and *visà voce*, that he or she has—

(1) A general knowledge of the management of a Dairy Farm, including the rearing and feeding of Dairy Stock, the candidate being required to satisfy the Examiners that he or she has had a thorough training and practical experience in all the details of Dairy work as pursued on a farm.

(2) A thorough acquaintance, both practical and scientific, with everything connected with the management of a Dairy, and the manufacture of Butter and Cheese.

¹ The National Agricultural Examination Board give notice that for the Examination in 1917 evidence will be required that a candidate has been on an approved Dairy farm for at least SIX months, which period must not run concurrently with that referred to in subsec. (1).

- (3) Practical skill in Dairying, to be tested by the making of Butter and Cheese.

NOTE.—A candidate must be prepared to make any one of the following varieties of Hard-pressed Cheese, the Examiner in Cheesemaking having the option of saying during the Examination what variety a candidate shall make:—

AT THE ENGLISH CENTRE—Cheddar, Cheshire, or Derby.

AT THE SCOTTISH CENTRE—Cheddar, Dunlop, or Cheshire.

- (4) Capacity for imparting instruction to others.

9. The Board reserve the right to postpone, to abandon, or in any way, or at any time, to modify an Examination, and also to decline at any stage to admit any particular candidate to the Examination.

DATES OF EXAMINATIONS IN 1916.

ENGLAND—SATURDAY, September 16th, and following days, at the University College and British Dairy Institute, Reading; last date for receiving applications, TUESDAY, August 15th.

SCOTLAND—FRIDAY, September 22nd, and following days, at the Dairy School for Scotland, Kilmarnock; last date for receiving applications, TUESDAY, August 15th.

SYLLABUS OF SUBJECTS OF EXAMINATION IN THE SCIENCE AND PRACTICE OF DAIRYING

I.—GENERAL MANAGEMENT OF A DAIRY FARM.

1. *General Management of Pastures and Crops on a Dairy Farm.*
2. *Buildings.*—Situation, Surroundings, Construction, Ventilation, and Drainage of Farm Buildings. Suitability of building materials. Water supply. Construction and arrangement of Dairies: (a) for General Purposes; (b) for Special Purposes.
3. *Foods and Feeding.*—Summer and Winter Feeding of Dairy Cattle. Root crops. Green fodder. Ensilage. Different kinds of food and their composition. Their effect upon Milk, Butter, and Cheese. Special Foods used in Dairy Feeding. Preparation of food for Dairy Stock. Rearing and feeding of young Stock. Feeding and management of Pigs and Poultry.
4. *Dairy Cattle in Health and Disease.*—Characteristics of different Breeds, and choice of Dairy Cattle. General functions of the organs of the animal body. Breeding. Parturition. Organs which secrete milk. Process of milk secretion. Changes which food undergoes during digestion. Diseases of Dairy Cattle and their remedies.

II.—MANAGEMENT OF DAIRY.

1. *Milk and Cream.*—Process of Milking. Dairy Utensils and Appliances, hand and power. Cooling of Milk. Separation and ripening of Cream. Different systems of Cream-raising. Utilisation of Skim-milk. Keeping of Milk. Importance of Cleanliness. Diseases spread by Milk. Conveyance and sale of Milk. Milk records. Keeping of Dairy and Farm Accounts. Creameries. Butter and Cheese Factories. Different systems of Dairying and their comparative returns.
2. *Butter.*—Churns and other Butter-making appliances, hand and power. Souring of Cream. Churning. Washing and working of Butter. Butter-milk. Packing and transmission of Butter. Salting and keeping of Butter. Colouring. Characteristics of good Butter.
3. *Cheese.*—Principles of its manufacture. Making of different kinds

of Cheese (from cream, whole-milk, and skim-milk). Acidity of Milk. Use of Rennet and its substitutes. Whey. Appliances for Cheese-making. Ripening and storage of Cheese. Packing and sale of Cheese. Making of Cream and other soft Cheeses.

III.—CHEMISTRY AND BACTERIOLOGY.

[*N.B.*—In this Section there will be expected of the candidate a sound understanding of the scientific principles underlying the practice of Dairying, a knowledge of the composition, nature, properties, and changes undergone by the different substances met with in Dairying, and a general acquaintance with the principles of laboratory methods so far as Dairying is concerned.]

1. *General Principles of Chemistry.*—The nature of elements and compound bodies. The different forms of matter—solid, liquid, gaseous. Specific gravity, and instruments for determining it. Temperature, and methods of measuring it. Thermometric scales. The influence of temperature in Dairy operations. Physical and chemical changes involved in the following: solution, precipitation, filtration, distillation, oxidation, and reduction. Acids, Bases, Salts—their distinctive properties. Acidity and Alkalinity—their influence and quantitative estimation.

The Atmosphere—its constituents and impurities; its influence on Dairy operations. Atmospheric pressure.

Water—constituents of pure and natural waters. The impurities of water, and whence derived. The importance of a pure water supply in Dairying.

General knowledge of the elementary chemistry of the following substances and their compounds so far as met with in Dairying: Potash, Soda, Ammonia, Lime, Phosphoric Acid, Alcohol, Acetic Acid, Carbonic Acid, Butyric Acid, Lactic Acid, Albumen, Casein, Fats, Milk-sugar, Glycerine, Pepsin.

Saponification of Fats.

2. *Milk and its Products.*—The nature, composition, properties, and chemical constituents of milk. Microscopical appearances presented by milk. The circumstances that affect the quality and quantity of milk produced by the cow. The influence of feeding. The changes which occur in the keeping of milk, and how produced. The natural and artificial souring of milk. Rennet, its nature and use. Physical and chemical changes involved in the making and keeping of Butter, and in the manufacture and ripening of Cheese. Separated Milk, Condensed Milk, Fermented Milk. The use of Preservatives. Methods of Milk-testing—Mechanical methods, their theory and practice. A general knowledge of the methods employed in the chemical analysis of Milk and Butter. Adulteration of Milk, Cream, Butter, and Cheese—the ways in which adulteration is practised, the changes in composition thereby produced, and a general knowledge of the methods employed in detecting the same.

3. *The Chemistry of Feeding.*—The principal constituents of Food materials, and the functions they severally fulfil. The influence of Food constituents on milk production. Assimilation and Digestion. Animal Heat and Respiration. Milk as a Food. The relation of Food to Manure.

4. *Bacteriology.*—Moulds. Yeasts. Bacteria. The principal kinds of Bacteria met with in Dairying—their forms, methods of reproduction, and conditions of life. The influence of physical agencies upon Bacterial life. Air and Water as carriers of Bacteria. The changes produced by Bacteria in milk and its products. Useful forms and their functions. Harmful forms and their effects—Coagulation, Discoloration, Taints, &c. Pathogenic organisms. The classification of organisms—organised ferments and enzymes. The isolation of Bacteria. Methods of preparation

of pure cultures and their practical use. Nutritive media. Soil Bacteriology—Assimilation of Nitrogen by Plants—Nitrification—Denitrification. Pasteurisation and Sterilisation—the practical application of these to Dairy matters. Fermentation and Putrefaction. Disinfectants and Preservatives.

N.B.—*Candidates are required to bring their Laboratory Notes to the Oral Examination in this subject.*

IV.—PRACTICAL SKILL IN DAIRY WORK.

Candidates must be prepared—(1) to produce at or before the Examination a satisfactory certificate of proficiency in the Milking of Cows, signed by a practical Dairy Farmer, and to satisfy the Examiners by a practical test, if so required; (2) to churn and make into Butter a measured quantity of Cream; and (3) to make one Cheese of each of the following varieties: (i) *Hard-pressed, of not less than 30 lb.; (ii) Veined or blue-moulded, of not less than 10 lb.; and (iii) also to make one or other of the following Soft Cheeses: Cambridge, Camembert, Coulommier, or Pont l'Évêque.

* A candidate must be prepared to make any one of the following varieties of Hard-pressed Cheese:—

AT THE ENGLISH CENTRE—Cheddar, Cheshire, or Derby.

AT THE SCOTTISH CENTRE—Cheddar, Dunlop, or Cheshire.

The Examiner in Cheesemaking will intimate the kind of Cheese to be made during the Examination.

V.—CAPACITY FOR IMPARTING INSTRUCTION TO OTHERS.

Candidates must also show practically that they are familiar with the management of a Dairy, and are capable of imparting instruction to others.

The following obtained the Diploma in Scotland in 1915:—

ROBERT C. R. BOYD, Allanbank, Fairlie.

RICHARD BRETHERTON, 38 Union Street, Leyland, near Preston.

MARGARET SUSAN COBBAN, Culmill, Kiltarlity, Beaulieu.

JEANNIE FARQUHARSON, Scotston, Inch.

ANNIE JANE HASTINGS, Ashcroft, Dalton, Lockerbie.

ANDREW M'BRIDE, Overton Farm, Kilmaurs.

ISABEL M'CUTCHEON, Kirkmabreck, Creetown.

JESSIE A. M'FARQUHAR, Dell, Ness, Lewis.

MARY FERGUSON M'GILVRA, Highlands Farm, Bowmore.

BARBARA MARY MORRIS, Killimster, Wick.

BHAILAL SHANKERBHAI PATEL, Bhadrán, *via* Borsad, India.

MARGE RAE, Southfield Cottage, Alma Place, Elgin.

ISABELLA ROSS, Burnside, Beaulieu.

CAROLINE CATHERINE SINCLAIR, Coronation Road, Wick.

MARGARET H. STEWART, 109 Bon Accord Street, Aberdeen.

ERNEST LEONARD TAYLOR, Ingleside, Ansdell Road, Lytham, Lancs.

ROBERT TAYLOR, Junr., 41 South Street, Greenock.

JOHN DUNLOP TENNANT, Glenouther, Stewarton.

FANNY WATTS, The Castle Farm, St George-super-Ely, near Cardiff.

MORFYDD WATTS, Llanmihangel Place, Cowbridge, Glamorgan.

JOHN WILSON, New Road, Mauchline.

JESSIE MITCHELL WYLLIE, Mossgeil, Mauchline.

The following obtained the Diploma in England in 1915 :—

- MAGGIE ASTLEY, Lancs. C.C. Dairy School, Hutton, Preston.
 ANN BRETHERTON, Lancs. C.C. Dairy School, Hutton, Preston.
 CONSTANCE BUTTERWORTH, University College and British Dairy Institute, Reading.
 MILES JOHN JAMES CLAYTON, Midland Agricultural and Dairy College, Kingston, Derby.
 KATHLEEN FREEAR, Midland Agricultural and Dairy College, Kingston, Derby.
 EVAN THOMAS JONES, University College of Wales, Aberystwyth.
 KATE KING, Midland Agricultural and Dairy College, Kingston, Derby.
 IDA MAUD LOOK, Midland Agricultural and Dairy College, Kingston, Derby.
 ANNIE M'GLASHAN, Lancs. C.C. Dairy School, Hutton, Preston.
 SYBIL MART, Lancs. C.C. Dairy School, Hutton, Preston.
 ALICE M. MOYLAN, University College and British Dairy Institute, Reading.
 ALICE MARY TAYLOR, Midland Agricultural and Dairy College, Kingston, Derby.
 KATHLEEN MARY THORNBERRY, University College and British Dairy Institute, Reading.
 HILDA EVELYN ELLINGWORTH, East Anglian Institute of Agriculture, Chelmsford.
 FLORENCE MAY TWOSE, University College and British Dairy Institute, Reading.

Two candidates (H. Poynton Borlase and Thomas Joseph Gripper) entered, in August 1914, for the Examination which took place in September of last year, but in consequence of their having, meanwhile, obtained Commissions in H.M. Army, they were prevented from presenting themselves for examination. Representations were made by the Registrar of the University College, Reading, and papers written by these two candidates in reply to special test questions set by the late manager of the British Dairy Institute were sent in on their behalf, with the request that their cases might receive special treatment. The National Agricultural Examination Board, after full consideration, decided, under the exceptional circumstances, to submit the papers to Professor Gilchrist and Mr John Benson for their opinion as to whether the written answers contained sufficient evidence of efficiency to justify the award of the National Diploma in Dairying. The Examiners having expressed the opinion that both the candidates in question were up to pass standard, the Diploma has been awarded to

- H. POYNTON BORLASE, S.E. Agricultural College, Wye ; University College and British Dairy Institute, Reading.
 THOMAS JOSEPH GRIPPER, S.E. Agricultural College, Wye ; University College and British Dairy Institute, Reading.

EXAMINATION PAPERS OF PAST YEARS.

Copies of the Papers set at the Annual Examinations for the National Diploma in the Science and Practice of Dairying held from 1896 to 1915, may, so far as available, be had on application. Price 6d. per set.

CHEMICAL DEPARTMENT

Chemist to the Society—J. F. TOCHER, D.Sc., F.I.C., Crown Mansions,
41½ Union Street, Aberdeen.

The object of the Chemical Department is to promote the diffusion of a knowledge of Chemistry as applied to agriculture among the members of the Society, to carry out experiments for that purpose, to assist members who are engaged in making local experiments requiring the direction or services of a chemist, to direct members in regard to the use of manures and feeding-stuffs, to assist them to put the purchase of these substances under proper control, and in general to consider all matters coming under the Society's notice in connection with the Chemistry of Agriculture.

MEMBERS' PRIVILEGES IN RESPECT TO ANALYSES.

MANURES, FEEDING-STUFFS, SOILS, AND
AGRICULTURAL PRODUCTS.

The fees for analyses made for members of the Society shall, until further notice, be as follows:—

The determination of one ingredient in a single sample of a <i>manure</i> or of a <i>feeding-stuff</i> ,	5s.
The determination of two or more ingredients in a single sample of a <i>manure</i> or of a <i>feeding-stuff</i> ,	10s.

For example—

Linseed and other cakes, for oil or for albuminoids,	5s.	}
Feeding-meals, ground cereals, for oil or for albuminoids,		
Bone-meals, for nitrogen or for phosphate,		
Compound manures, for nitrogen or for soluble phosphates, or for insoluble phosphates or for potash,		
Superphosphate, for soluble phosphate or for insoluble phosphate,		
Thomas-phosphate powder, for citric soluble phosphate or for total phosphate,	10s.	}
Linseed and other cakes, for oil and albuminoids, &c.,		
Feeding-meals, ground cereals, for oil, albuminoids, &c.,		
Bone-meals, for nitrogen, phosphate, &c.,		
Compound manures, for nitrogen, soluble phosphates, insoluble phosphates, and potash,		
Superphosphate, for soluble phosphate and insoluble phosphate,	£0 5 0	
Thomas-phosphate powder, for citric soluble phosphate and total phosphate,		
Limestone, giving the percentage of lime,		
Limestone, complete analysis,		
Lime, including ground lime, percentage of alkaline lime, " " " complete analysis,		
Analysis of soil, to determine fertility and recommenda- tion of manurial treatment,	1 10 0	
Complete analysis of soil,	2 10 0	
Analysis of agricultural products—hay, grain, ensilage, roots, &c.,	1 0 0	

These charges apply only to analyses made for agricultural purposes, and for the sole and private use of members of the Highland and Agricultural Society who are not engaged in the manufacture or sale of the substances analysed.

Valuations of manures, according to the Society's scale of units, will be supplied if requested.

DAIRY PRODUCE.

Milk, full analysis,	£0 10 0
" solids and fat,	0 5 0
" fat only,	0 2 6
Butter, full analysis,	0 10 0
" partial analysis (water and fat),	0 5 0
Cheese,	0 10 0

WATER.

Analysis of water ¹ to determine purity and fitness for domestic use (the Committee reserve power to refuse from one member more than two samples annually at the reduced fee).....at the reduced fee of	1 0 0
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MISCELLANEOUS.

Search for poisons in food or viscera,	2 0 0
Sulphate of copper, percentage of copper and purity,	0 5 0
" " complete analysis,	0 10 0
Arsenic, carbolic acid and tar acids, and other poisons used in making sheep dips, insecticides, &c.,	5s. to £1
Samples should be sent (carriage paid) to Dr J. F. Tocher, Crown Mansions, 41½ Union Street, Aberdeen.	

Note to Members sending Samples for Analysis.

The Directors are anxious to take any steps in their power to expose the vendors of inferior fertilisers and feeding-stuffs, and the members can give them assistance in this by supplying to the chemist, when sending samples for analyses, information as to the guarantee, if any, on which the goods were sold, and also as to the price charged.

INSTRUCTIONS FOR SELECTING SAMPLES FOR ANALYSIS.

MANURES.

Any method of sampling mutually agreed upon between buyer and seller may be adopted, but the following method is recommended as a very complete and satisfactory one: Four or more bags should be selected for sampling. Each bag is to be emptied out separately on a clean floor, worked through with the spade, and one spadeful taken out and set aside. The four or more spadefuls thus set aside are to be mixed together until a uniform mixture is obtained. Of this mixture one spadeful is to be taken, spread on paper, and still more thoroughly mixed, any lumps which it may contain being broken down with the hand. Of this mixture two samples of about half a pound each should be taken by the purchaser or his agent, in the presence of the seller or his agent or two witnesses (due notice having been given to the seller of the time and place of sampling), and these samples should be taken as quickly as possible, and put into bottles or tin cases to prevent loss of moisture, and having been labelled, should be sealed by the samplers—one or more samples to be retained by the purchaser, and one to be sent to the chemist for analysis.

¹ Cases containing bottles for water samples and instructions for sampling are sent from the laboratory on application.

FEEDING-STUFFS.

Samples of feeding-stuffs which are in the form of meal may be taken in a similar manner.

Samples of cake should be taken by selecting four or more cakes from the bulk. These should be nuted to a size not larger than walnuts. The nuted cake should then be thoroughly mixed and samples of not less than one pound each taken from it. The samples should be put into bottles or tins, sealed up, and labelled. One sample should be sent to the analyst, and one or more duplicates retained by the purchaser.

SOILS.

Dig a little trench about two feet deep, exposing the soil and subsoil. Cut from the side of this trench vertical scrapings of the soil down to the top of the subsoil. Catch these on a clean board, and collect in this manner two pounds of soil taken from the whole surface of the section. Similar scrapings of subsoil immediately below should be taken and preserved separately. Five or six similarly drawn samples at least should be taken from different parts of the field, and kept separate while being sent to the chemist, that he may examine them individually before mixing in the laboratory.

VEGETABLE PRODUCTS.

Turnips, &c., at least 50 bulbs carefully selected as of fair average growth.

Hay, straw, ensilage, &c., should be sampled from a thin section cut across the whole stack or silo, and carefully mixed; above 2 lb. weight is required for analysis.

Grain should be sampled like manures.

DAIRY PRODUCE.

Milk.—Samples of milk from individual cows should be taken direct from the milk-pail after complete milking. Average samples from a number of cows should be taken immediately after milking. Specify whether the sample is morning or evening milk, or a mixture of these. Samples to be tested for adulteration should not be drawn from the bottom or taken from the top of standing milk, but they should be ladled from the vessel after the milk has been thoroughly mixed. Samples of milk should be sent immediately to the analyst.

For most purposes a half-pint bottle of milk is a large enough sample.

Butter and Cheese.—About quarter-pound samples are required.

WATERS.

When the water is from a well, it should be pumped for some minutes before taking the sample.

If the well has been standing unused for a long time, it should be pumped for some hours, so that the water may be renewed as far as possible.

If the well has been newly dug or cleaned out, it should be pumped as dry as possible, daily, for a week before taking the sample.

Water from cisterns, tanks, ponds, &c., should be sampled by immersing the bottle entirely under the water, and holding it, neck upwards, some inches below the surface. *Water from the surface should not be allowed to enter the bottle.*

Spring or stream water should not be sampled in very wet weather, but when the water is in ordinary condition. Such waters should be sampled by immersing the bottle, if possible; but if not deep enough for that purpose, a perfectly clean cup should be used for transferring the water to the bottle.

When the bottle has been filled the stopper should be rinsed in the water before replacing it.

Interference with or disturbance of wells or springs, or the ground in their immediate vicinity, must be carefully avoided during sampling, and for at least twenty-four hours before it.

After a sample has been taken, it should be sent to the laboratory as speedily as possible.

A description of the source and circumstances of the water should accompany the sample, as the interpretation of the analytical results depends to some extent on a knowledge of such particulars.

N.B.—Stone jars and old wine bottles are unsuitable for conveying samples. Winchester quarts chemically cleaned should be obtained from the laboratory, Crown Mansions, 41½ Union Street, Aberdeen.

LOCAL ANALYTICAL ASSOCIATIONS.

With the view of encouraging, as well as regulating the conduct of, Local Analytical Associations, the Society, from 1881 to 1893, contributed from its funds towards their expenses a sum not exceeding £250 annually. In view of the passing of the Fertilisers and Feeding Stuffs Act, 1893, it was decided, at a meeting of the Directors on the 6th of December 1893, to discontinue that grant after the 1st of March 1894.

COMPOSITION AND CHARACTERISTICS OF MANURES AND FEEDING-STUFFS.

(See '*Transactions, Fifth Series, vol. xi. 1899.*')
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FORMS OF GUARANTEE

GUARANTEE OF MANURE.

I guarantee that the manure called.....and sold by me to
.....contains a minimum of—

Soluble phosphoric acid = Phosphate of lime dissolved.....per cent.

Insoluble phosphoric acid = Phosphate of lime undissolved.....per cent.

Potash salts : : = Potash (K_2O) : : :per cent.

Total nitrogen : : = Ammonia : : :per cent.

Signature of seller.....

Date.....19...

GUARANTEE OF FEEDING-STUFF.

I guarantee that the feeding-stuff called.....and sold by me to
.....contains a minimum of—

..... per cent albuminoids.

..... per cent oil.

..... per cent carbohydrates.

Signature of seller.....

Date.....19...

FEEDING-STUFFS.					
	Average Analyses.			Price per ton at Glasgow.	Price per ton at Leith.
	Album.	Oil.	Carbo-hydrates.		
	Per cent.	Per cent.	Per cent.	£ s d.	£ s d.
Linseed-cake (home)	29	9	84	13 15 0	13 17 6
" (foreign)	30	8	84	13 10 0	13 10 0
Decorticated cotton-cake	40	9	24	13 17 6	14 0 0
Undecorticated " (Egyptian)	22	5½	84	11 15 0	11 10 0
" " (Bombay)	19	4½	36	11 0 0	11 5 0
Soya-bean cake	40	6	80	12 15 0	..
Cocoonut cake	21	10	40	11 5 0	..
Palm-nut kernel cake	18	6	45	10 10 0	10 5 0
Ground-nut cake (decorticated)	44	9	23	12 10 0	12 15 0
Soya-bean meal . . . . .	..	..	..	..	..
Bean-meal *	25	1½	48	14 0 0	13 5 0
Maize meal	10½	5	70	13 5 0	12 17 6
Rice meal	12	12	50	11 0 0	10 10 0
Locust-bean meal	6	1½	70	10 5 0	10 10 0
Wheat bran (medium)	15	4	56	9 10 0	9 10 0
" (broad)	15	4	54	10 0 0	10 5 0
Wheat middlings	15	3½	..	11 7 6	10 15 0
Wheat sharps	15	4½	57	9 10 0	9 10 0
Dried distillery grains †	20	8	45	9 10 0	9 10 0
Brewer's grains dried †	20	6	45	9 5 0	9 0 0
Indian corn (maize) *	10½	5	70	13 0 0	12 7 6
Feeding treacle	10	0	60	11 10 0	11 0 0
Crushed linseed	23	35	23	25 0 0	25 0 0
Fish meal	54	2	0	..	12 0 0

* These are the February prices, but they are subject to variation from month to month, or oftener.
 † Bags included.

CLASSIFICATION OF FERTILISERS.

Peruvian guano	{	Guanos with over 4 per cent of nitrogen are to be considered as nitrogenous. Those with less than this percentage are to be classed as phosphatic guano.
Bone-meal	{	Genuine bone-meal contains from 48 per cent to 55 per cent phosphates, and from 3½ per cent to 4½ per cent nitrogen. If phosphates are low, nitrogen will be high, and conversely.
Steamed bone-flour	{	Ground to flour, and containing about 60 to 70 per cent phosphates and about 1 to 1½ per cent nitrogen.
Dissolved bones	{	Must be pure—i.e., containing nothing but bones and sulphuric acid.
Mixtures and compound manures	{	No recommendation is made as to the valuation of mixtures and compound manures for this year.
Basic slag (Thomas-phosphate powder)	{	Citric soluble phosphate means phosphate soluble in citric acid in accordance with the official method of Board of Agriculture. Fineness of grinding is of importance. The coarsest kind used should be so finely ground that at least 80 per cent passes through a wire sieve of about 9600 holes per sq. inch.

INSTRUCTIONS FOR VALUING FERTILISERS.

The unit used for the valuation of fertilisers is the hundredth part of a ton, and as the analyses of fertilisers are expressed in parts per hundred, the percentage of any ingredient of a fertiliser when multiplied by the price of the unit of that ingredient represents the value of the quantity of it contained in a ton.

Note.—The units have reference solely to the MARKET PRICE of Fertilisers at 2nd February 1916, and not to their AGRICULTURAL VALUES.

BOTANICAL DEPARTMENT

Consulting Botanist to the Society—A. N. M'ALPINE,
6 Blythswood Square, Glasgow.

The Society have fixed the following rates of charge for the examination of plants and seeds for the *bona fide* and individual use and information of members of the Society (not being seedsmen), who are particularly requested, when applying to the Consulting Botanist, to mention the kind of examination they require, and to quote its number in the subjoined schedule. The charge for examination must be paid at the time of application, and the carriage of all parcels must be prepaid.

Scale of Charges.

1. A report on the purity, amount, and nature of foreign materials, and the germinating power of a sample of seed, 1s.
2. Determination of the species of any weed or other plant, or of any vegetable parasite, with a report on its habits and the means for its extermination or prevention, 1s.
3. Report on any disease affecting farm crops, 1s.
4. Determination of the species of any natural grass or fodder plant, with a report on its habits and pasture or feeding value, 1s.

The Consulting Botanist's Reports are furnished to enable members—purchasers of seeds and corn for agricultural or horticultural purposes—to test the value of what they buy, and are not to be used or made available for advertising or trade purposes by seedsmen or otherwise.

Purchase of Seeds.

The purchaser should obtain from the vendor, by invoice or other writing, the proper designation of the seed he buys, with a guarantee of the percentage of purity and germination, and of its freedom from ergot, and in the case of clover, from the seeds of dodder or broom-rape.

It is strongly recommended that the purchase of *prepared mixtures* of seeds should be avoided. The different seeds should be purchased separately and mixed by the farmer: mixtures cannot be tested for germination.

The Sampling of Seeds.

The utmost care should be taken to secure a fair and honest sample. This should be drawn from the bulk delivered to the purchaser, and not from the sample sent by the vendor.

When legal evidence is required, the sample should be taken from the bulk, and placed in a sealed bag in the presence of a witness. Care should be taken that the sample and bulk be not tampered with after delivery, or mixed or brought in contact with any other sample or bulk.

At least one ounce of grass and other small seeds should be sent, and two ounces of cereals and the larger seeds. When the bulk is obviously impure the sample should be at least double the amount specified. Grass seeds should be sent at least four weeks, and seeds of clover and cereals two weeks, before they are to be used.

The exact name under which the sample has been sold and purchased should accompany it.

Reporting the Results.

The Report will be made on a schedule in which the nature and amount of impurities will be stated, and the number of days each sample has been under test, with the percentage of the seeds which have germinated.

"Hard" clover seeds, though not germinating within the time stated, will be considered good seeds, and their percentage separately stated.

The impurities in the sample, including the chaff of the species tested, will be specified in the schedule, and only the percentage of the pure seed of that species will be reported upon; but the REAL VALUE of the sample will be stated. The Real Value is the combined percentages of purity and germination, and is obtained by multiplying these percentages and dividing by 100: thus in a sample of Meadow Fescue having 88 per cent purity and 95 per cent germination, 88 multiplied by 95 gives 8360, and this divided by 100 gives 83·6, the Real Value.

Selecting Specimens of Plants.

The whole plant should be taken up and the earth shaken from the roots. If possible the plants must be in flower or fruit. They should be packed in a light box, or in a firm paper parcel.

Specimens of diseased plants or of parasites should be forwarded as fresh as possible. They should be placed in a bottle, or packed in tinfoil or oil-silk.

All specimens should be accompanied with a letter specifying the nature of the information required, and stating any local circumstances (soil, situation, &c.) which, in the opinion of the sender, would be likely to throw light on the inquiry.

Parcels or letters containing seeds or plants for examination (carriage or postage paid) must be addressed to Professor M'Alpine, Botanical Laboratory, 6 Blythswood Square, Glasgow.

ENTOMOLOGICAL DEPARTMENT

Consulting Entomologist to the Society—Dr R. STEWART MACDOUGALL,
9 Dryden Place, Edinburgh.

Arrangements have been made with Mr R. Stewart MacDougall, M.A., D.Sc., Edinburgh, to advise members of the Society regarding insects or allied animals which, in any stage of their development, infest—

- | | | |
|-----------------------------------|--|-------------------------------------|
| (a) Farm crops. | \| | (d) Fruit and fruit trees. |
| (b) Stored grain. | \| | (e) Forest trees and stored timber. |
| (c) Garden and greenhouse plants. | \| | (f) Live stock (including poultry). |

Members consulting Dr MacDougall will please forward with their queries examples of the injured plants, or the injured parts of plants, &c., as well as specimens of the insects or other animals believed to be the cause of the injury.

Specimens should be sent in tin or wooden boxes, or in quills, to prevent injury in transmission.

Address letters and parcels (carriage or postage paid) to Dr R. Stewart MacDougall, 9 Dryden Place, Edinburgh.

The Directors have fixed the fee payable by members to Dr MacDougall at 1s. for each case upon which he is consulted: this fee must be sent to him along with the application for information.

PREMIUMS

GENERAL REGULATIONS FOR COMPETITORS.

1. It is to be distinctly understood that the Society is not responsible for the views, statements, or opinions of any of the writers whose papers are published in the 'Transactions.'

2. All reports must be legibly written, and on one side of the paper only; they must specify the number and subject of the Premium for which they are in competition; they must bear a distinguishing motto, and be accompanied by a sealed letter, similarly marked, containing the name and address of the reporter—initials must not be used.

3. No sealed letter, unless belonging to a report found entitled to the Premium offered, or a portion of it, will be opened without the author's consent.

4. Reports for which a Premium, or a portion of a Premium, has been awarded, become the property of the Society, and cannot be published in whole or in part, nor circulated in any manner, without the consent of the Directors. All other papers will be returned to the authors if applied for within twelve months.

5. The Society is not bound to award the whole or any part of a Premium.

6. All reports must be of a practical character, containing the results of the writer's own observation or experiment, and the special conditions attached to each Premium must be strictly fulfilled. General essays, and papers compiled from books, will not be rewarded or accepted. Weights and measurements must be indicated by the imperial standards.

7. The Directors, before or after awarding a Premium, shall have power to require the writer of any report to verify the statements made in it.

8. The decisions of the Board of Directors are final and conclusive as to all matters relating to Premiums, whether for Reports or at General or District Shows; and it shall not be competent to raise any question or appeal touching such decisions before any other tribunal.

9. The Directors will welcome papers from any Contributor on any suitable subject, whether included in the Premium List or not; and if the topic and the treatment of it are both approved, the writer may be remunerated and his paper published.

CLASS I. REPORTS.

SECTION 1.—THE SCIENCE AND PRACTICE OF AGRICULTURE.

FOR APPROVED REPORTS.

1. On any useful practice in Rural Economy adopted in other countries, and susceptible of being introduced with advantage into Scotland—The Gold Medal. To be lodged by 1st November in any year.

The purpose chiefly contemplated by the offer of this premium is to induce travellers to notice and record such particular practices as may seem calculated to benefit Scotland. The Report to be founded on personal observation.

2. Approved Reports on other suitable subjects. To be lodged by 1st November in any year.

SECTION 2.—ESTATE IMPROVEMENTS.

FOR APPROVED REPORTS.

1. By the Proprietor in Scotland who shall have executed the most judicious, successful, and extensive Improvement—The Gold Medal, or Ten Sovereigns. To be lodged by 1st November in any year.

Should the successful Report be written for the Proprietor by his resident factor or farm manager, a Minor Gold Medal will be awarded to the writer in addition to the Gold Medal to the Proprietor.

The merits of the Report will not be determined so much by the mere extent of the improvements, as by their character and relation to the size of the property. The improvements may comprise reclaiming, draining, enclosing, planting, road-making, building, and all other operations proper to landed estates. The period within which the operations may have been conducted is not limited, except that it must not exceed the term of the Reporter's proprietorship.

2. By the Proprietor or Tenant in Scotland who shall have reclaimed within the ten preceding years not less than forty acres of Waste Land—The Gold Medal, or Ten Sovereigns. To be lodged by 1st November in any year.

3. By the Tenant in Scotland who shall have reclaimed within the ten preceding years not less than twenty acres of Waste Land—The Gold Medal, or Ten Sovereigns. To be lodged by 1st November in any year.

4. By the Tenant in Scotland who shall have reclaimed not less than ten acres within a similar period—The Medium Gold Medal, or Five Sovereigns. To be lodged by 1st November in any year.

The Reports in competition for Nos. 2, 3, and 4 may comprehend such general observations on the improvement of waste lands as the writer's

experience" may lead him to make, but must refer especially to the lands reclaimed—to the nature of the soil—the previous state and probable value of the subject—the obstacles opposed to its improvement—the details of the various operations—the mode of cultivation adopted—and the produce and value of the crops produced. As the required extent cannot be made up of different patches of land, the improvement must have relation to one subject; it must be of profitable character, and a rotation of crops must have been concluded before the date of the Report. *A detailed statement of the expenditure and return and a certified measurement of the ground are requisite.*

5. By the Proprietor or Tenant in Scotland who shall have improved within the ten preceding years the Pasturage of not less than thirty acres, by means of top-dressing, draining, or otherwise, without tillage, in situations where tillage may be inexpedient—The Gold Medal, or Ten Sovereigns. To be lodged by 1st November in any year.

6. By the Tenant in Scotland who shall have improved not less than ten acres within a similar period—The Minor Gold Medal. To be lodged by 1st November in any year.

Reports in competition for Nos. 5 and 6 must state the particular mode of management adopted, the substances applied, the elevation and nature of the soil, its previous natural products, and the changes produced.

SECTION 3.—HIGHLAND INDUSTRIES AND FISHERIES.

FOR APPROVED REPORTS.

1. The best mode of treating native Wool; cleaning, carding, dyeing, spinning, knitting, and weaving by hand in the Highlands and Islands of Scotland—Five Sovereigns. To be lodged by 1st November in any year.

SECTION 4.—MACHINERY.

FOR APPROVED REPORTS.

To be lodged by 1st November in any year.

SECTION 5.—FORESTRY DEPARTMENT.

FOR APPROVED REPORTS.

1. On Plantations of not less than eight years' standing formed on deep peat-bog—The Medium Gold Medal, or Five Sovereigns. To be lodged by 1st November in any year.

The premium is strictly applicable to deep peat or flow moss; the condition of the moss previous to planting, as well as at the date of the Report, should, if possible, be stated.

The Report must describe the mode and extent of the drainage, and the effect it has had in subsiding the moss—the trenching, levelling, or other preliminary operations that may have been performed on the surface—the mode of planting—kinds, sizes, and number of trees planted per acre—and their relative progress and value, as compared with plantations of a similar age and description grown on other soils in the vicinity.

CLASS II.

DISTRICT COMPETITIONS.

REGULATIONS 1916.

Grants in aid of DISTRICT COMPETITIONS for 1917 must be applied for before 1st November 1916, on Forms to be obtained from the Secretary.

When a Money Grant has expired, the District cannot apply again for another Money Grant for four years.

SECTION I.—GRANTS TO DISTRICT SOCIETIES FOR HORSES, CATTLE, SHEEP, AND PIGS.

1. CLASS OF STOCK—LIMIT OF GRANTS, £340.—The Highland and Agricultural Society will make Grants to District Societies for prizes for *Breeding Animals* of any of the following Classes of Stock, viz. :—

<i>Cattle.</i>	<i>Sheep.</i>
Shorthorn.	Blackface.
Aberdeen-Angus.	Cheviot.
Galloway.	Border Leicester.
Highland.	Half-Bred.
Ayrshire.	Shropshire.
Holstein-Friesian.	Oxford-Down.
Jersey.	Suffolk.
	Wensleydale.
<i>Horses.</i>	<i>Pigs.</i>
Draught Horses.	Any Pure Breed.
Hunters.	
Hackneys.	
Ponies.	
Shetland Ponies.	

Cross-bred¹ animals are not eligible. The Prizes must be confined to *Breeding Animals*; "bullocks," "geldings," "wethers," and "hog pigs" are excluded.

2. All Competitions must be at the instance of a local Society. A Committee of Management shall be appointed, and the Convener of the Committee must be a Member of the Highland and Agricultural Society.

3. GRANT TO DISTRICT, £12.—The portion of the Grant to any one District Society shall not exceed the sum of £12 in any one year.

4. ALLOCATION OF GRANT.—The Grant from the Highland and Agricultural Society is not to be applied as a Grant in aid of the Premiums offered by the Local Society, but must be offered in the form of separate Prizes for the Animals chosen; and the Prizes must be announced in the Premium List and Catalogue of the Show as "given by the Highland and Agricultural Society."

5. CONTINUANCE OF GRANT THREE YEARS.—The Money Grant shall continue for three alternate years, provided always that the District Society shall, in the two intermediate years, continue the competition by offering Premiums for the same class of Stock as that selected in each previous year to compete for the Highland and Agricultural Society's Prizes. If no competition takes place for two years the Grant expires.

¹ Exceptions to this rule may, however, be authorised by the Board of Directors, on application. The Directors are prepared to consider applications from local Societies which desire to use their grants, or part thereof, as prizes for cross-bred calves and one-year-old cross-bred cattle.

6. When it is agreed to hold the General Show of the Society in any district, no provincial show shall be held in that district in the months of June, July, or August.

7. MEDALS IN INTERMEDIATE YEARS.—In the two alternate years the Highland and Agricultural Society will place three Silver Medals at the disposal of the District Societies, for the same classes of Stock as those for which the Money Premiums are offered, provided that not less than three lots are exhibited in the same class.

8. RULES OF COMPETITION.—The Rules of Competition for the Premiums, the Funds for which are derived from Grants of the Highland and Agricultural Society, shall be such as are generally enforced by the Society receiving the Grant for Premiums offered by itself.

9. AREA AND PARISHES—FIVE PARISHES.—When making application for Grants from the Highland and Agricultural Society, the District Society must delineate the area and the number of parishes comprised in the district, and, *except in special cases*, no District Society shall be entitled to a Grant whose show is not open to at least five Parishes.

10. REPORTS.—Blank Forms for Reports will be furnished to the Secretaries of the different District Societies. Both in the years when the Grant is offered and in the two intermediate years, detailed reports of the competition must be given on these Forms and lodged with the Secretary of the Highland and Agricultural Society as soon as possible after the Show, and in no case later than 1st November. These reports are subject to the approval of the Directors of the Highland and Agricultural Society, against whose decision there shall be no appeal. All Reports must be signed and certified as marked in the Form.

11. GRANTS—WHEN PAID.—The Grants made to District Societies will be paid in December after the Reports of the awards of the prizes have been received and found to be in order and passed by the Board of Directors, the Money Grants being paid to the Secretaries of the Local Societies and the Medals sent direct to the winners. *The Secretary of the District Society must not on any condition whatever pay any premium offered by the Highland and Agricultural Society until he has been informed that the awards are in order and has received the Grant from the Highland and Agricultural Society.*

12. RENEWAL OF APPLICATION.—No application for renewal of a Money Grant to a District Society will be entertained until the expiration of four years from the termination of the last Grant.

13. DISPOSAL OF APPLICATIONS.—In disposing of applications for District Grants, the Directors of the Highland and Agricultural Society shall keep in view the length of interval that has elapsed since the expiration of the last Grant, giving priority to those District Societies which have been longest off the list.

DISTRICTS.

Final Year.

1. NITHSDALE AGRICULTURAL SOCIETY.—*Convener*, Charles W. Ralston, Dabton, Thornhill; *Secretary*, David Paterson, Solicitor, Thornhill. Granted 1909. (In abeyance in 1910 on account of the Dumfries Show.) (In abeyance 1914 and 1915—no Show held.)
2. WESTER ROSS FARMERS' CLUB.—*Convener*, William Stirling, Fairburn, Muir of Ord; *Secretary*, James Cumming, County Buildings, Dingwall. Granted 1909. (In abeyance in 1911 on account of the Inverness Show.) (In abeyance 1914 and 1915—no Show held.)
3. STRATHSPEY FARMERS' CLUB.—*Convener*, J. Grant Smith, Strathspey Estate Office, Grantown-on-Spey; *Secretary*, Gilbert Brown,

Grantown-on-Spey. Granted 1909. (In abeyance in 1911 on account of the Inverness Show.) (In abeyance 1914 and 1915—no Show held.)

4. CLACKMANNANSHIRE UNION AGRICULTURAL SOCIETY.—*Convener*, Donald A. Kinross, Hillend, Clackmannan; *Secretary*, Alexander L. Roxburgh, Solicitor, Alloa. Granted 1911. (In abeyance 1915—no Show held.)
5. STRATHENDRICK AGRICULTURAL SOCIETY.—*Convener and Secretary*, W. Watson Murray, Catter House, Drymen. Granted 1911. (In abeyance 1915—no Show held.)
6. LARGS, CUMBRAE, AND WEMYSS BAY AGRICULTURAL SOCIETY.—*Convener*, J. W. Crawford, Kilburn, Largs; *Secretary*, Neil Mitchell, 1 Gallowgate Square, Largs. Granted 1911. (In abeyance in 1913 on account of the Paisley Show.)
7. DOUNE AGRICULTURAL ASSOCIATION.—*Convener*, John Scrimgeour, Doune Lodge, Doune; *Secretary*, William Gray, Doune. Granted 1912.
8. EASTERN DISTRICT OF STIRLINGSHIRE AGRICULTURAL ASSOCIATION.—*Convener*, William T. Malcolm, Dunmore, Larbert; *Secretary*, Robert Waugh, Newmarket Street, Falkirk. Granted 1912.

2nd Year.

9. ARGYLL CATTLE SHOW SOCIETY.—*Convener*, Captain John Campbell of Kilberry; *Secretary*, James M'Dougall, South Cliff, Tarbert, Lochfyne. Granted 1910. (In abeyance in 1910—unable to hold a show. In abeyance in 1913 on account of the Paisley Show.) (In abeyance 1914 and 1915—no Show held.)
10. CASTLE DOUGLAS AGRICULTURAL SOCIETY.—*Convener*, Charles A. Phillips of Dildawn, Castle Douglas; *Secretary*, Patrick Gifford, 118 King Street, Castle Douglas. Granted 1912. (In abeyance 1912 and 1915—no Show held.)
11. YTHANSIDE FARMERS' CLUB.—*Convener*, William Kemp, Aldie, Port Erroll; *Secretary*, John Mark, Bank Agent, Ellon. Granted 1914.
12. KILLEARN AGRICULTURAL SOCIETY.—*Convener*, C. E. Horsburgh, Blairquhosh, Blanefield; *Secretary*, Robert N. Morrison, Dumgoyach, Blanefield, Stirlingshire. Granted 1914.

1st Year.

13. EASTER ROSS FARMERS' CLUB.—*Convener*, James G. Young, Cadboll, Fearn; *Secretary*, George D. Gill, Commercial Bank Buildings, Tain. Granted 1914. (In abeyance 1914 and 1915—no Show held.)
14. FORTH AGRICULTURAL SOCIETY.—*Convener*, David M'Culloch, The Inn, Forth; *Secretary*, George Muir, East Crofthill, Carnwath. Granted 1915. (In abeyance 1915—no Show held.)
15. MOUNT BLAIR AGRICULTURAL SOCIETY.—*Convener*, James M'L. Marshall, Bleaton Hallet, Blairgowrie; *Secretaries*, J. Stewart and J. Mitchell, Bleaton, Blairgowrie. Granted 1915. (In abeyance 1915—no Show held.)
16. BUCHLYVIE AND GARTMORE AGRICULTURAL SOCIETY.—*Convener*, John Dempster, Estates Office, Gartmore; *Secretary*, James Monach, Craignorton, Buchlyvie. Granted 1916.
17. DUMBARTONSHIRE AGRICULTURAL SOCIETY.—*Convener*, A. C. Lawrie, Muirhouses, Duntocher; *Secretary*, William Davie, 253 Main Street, Alexandria. Granted 1916.
18. INVERNESS-SHIRE FARMERS' SOCIETY.—*Convener*, P. B. Macintyre, Findon, Canon Bridge; *Secretary*, Fred. J. Baxter, Royal Bank Buildings, Inverness. Granted 1916.

19. UPPER WARD OF LANARKSHIRE AGRICULTURAL SOCIETY.—*Convener*, David M'Culloch, Forth; *Secretary*, William Shaw, Royal Bank House, Lanark. Granted 1916.

(In Intermediate Year—3 Silver Medals.)

20. MOFFAT AND UPPER ANNANDALE AGRICULTURAL AND HORTICULTURAL SOCIETY.—*Convener*, Basil H. Hill, Archbank, Moffat; *Secretaries*, James Johnstone, Solicitor, Moffat, and John Young, High Street, Moffat. Granted 1911. (In abeyance 1914 and 1915—no Show held.)
21. GLENKENS AGRICULTURAL SOCIETY.—*Convener*, J. M. Kennedy, Knocknalling, Dalry; *Secretary*, James M'Gill, High Street, New Galloway. Granted 1911. (In abeyance 1914 and 1915—no Show held.)
22. STRATHBOGIE FARMER CLUB.—*Convener*, William Wilson, Coynachie, Gartly; *Secretary*, William M. Morrison, Cairnie, Huntly. Granted 1912. (In abeyance 1915—no Show held.)
23. ISLAY, JURA, AND COLONSAY AGRICULTURAL ASSOCIATION.—*Convener*, James Forbes, Eallabus, Bridgend, Islay; *Secretary*, Robert Cullen, Bridgend, Islay. Granted 1912. (In abeyance in 1913 on account of the Paisley Show.) (In abeyance 1914 and 1915—no Show held.)
24. FORMARTINE AGRICULTURAL ASSOCIATION.—*Convener*, George Walker, Tillygreig, Udney Station; *Secretary*, James Skinner, Mosstown Cottage, Logierive, Udney. Granted 1913.
25. LIDDESDALE AGRICULTURAL SOCIETY.—*Convener*, David Ballantyne, Shaws, Newcastleton; *Secretary*, Robert Brown, British Linen Bank, Newcastleton. Granted 1913. (In abeyance in 1914 on account of the Hawick Show.) (1915—no Show held.)
26. YARROW AND ETTRICK PASTORAL.—*Convener*, Walter Barrie, Sundhope, Selkirk; *Joint-Secretaries*, Walter Barrie and John Johnstone, Sundhope, Selkirk. Granted 1913. (In abeyance in 1914 on account of the Hawick Show.) (1915—no Show held.)
27. ARDOCH AGRICULTURAL SOCIETY.—*Convener*, Robert Miller, Overardoch, Braco; *Secretary*, John Maxton, Rhynd, Braco, Perthshire. Granted 1914. (In abeyance 1915—no Show held.)
28. CROMAR, UPPER DEE, AND DONSIDE AGRICULTURAL SOCIETY.—*Convener*, William H. Coltman of Tillypoonie, Tarland; *Secretary*, William Anderson, Home Farm, Hopewell, Tarland. Granted 1915.
29. ARRAN FARMERS' SOCIETY.—*Convener*, James J. Morton, Machrie, Arran; *Secretary*, James Bone, jun., Glenkiln, Lamash. Granted 1915.
30. CARRICK FARMERS' SOCIETY.—*Convener*, Alexander Cross of Knockdon, Maybole; *Secretaries*, J. & J. M. Gibson, Royal Bank, Maybole. Granted 1915.
31. UNITED BANFFSHIRE AGRICULTURAL SOCIETY.—*Convener*, Alexander Murray, Old Manse, Boyndie, Banff; *Secretary*, John A. Badenoch, 27 High Street, Banff. Granted 1915.
32. MORAYSHIRE FARMER CLUB.—*Convener*, C. J. Johnston of Lesmurdie, Elgin; *Secretary*, W. Rose Black, Solicitor, Elgin. Granted 1915.
33. LANARKSHIRE FARMERS' SOCIETY.—*Convener*, T. Douglas Wallace, Callendar Estates Office, Falkirk; *Secretary*, James Cassels, Union Bank of Scotland, Hamilton. Granted 1915.

(In Abeyance 1916.)

34. UNITED EAST LOTHIAN AGRICULTURAL SOCIETY.—*Convener*, Thomas Elder of Stevenson Mains, Haddington; *Secretary*, John Stirling, Solicitor, Haddington. Granted 1911. (In abeyance in 1915 and 1916 on account of the Edinburgh Show.)
35. DALKEITH AGRICULTURAL SOCIETY.—*Convener*, Phipps O. Turnbull, Smeaton, Dalkeith; *Secretary*, James W. Speedy, Braeside, Liberton. Granted 1916. (In abeyance in 1916 on account of the Edinburgh Show.)

In 1916.

- Nos. 1, 2, 3, 4, 5, 6, 7, and 8 are in competition for the final year.
 Nos. 9, 10, 11, and 12 are in competition for the second year.
 Nos. 13, 14, 15, 16, 17, 18, and 19 are in competition for the first year.
 Nos. 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, and 33 are in intermediate year and compete for local Premiums. (See Rules 5 and 7.)
 Nos. 34 and 35 are in abeyance on account of the Edinburgh Show.

SECTION 2.—GRANTS TO HORSE ASSOCIATIONS, &c., FOR STALLIONS FOR AGRICULTURAL PURPOSES.

1. The Highland and Agricultural Society will make Grants to Horse Associations and other Societies in different districts engaging Stallions for agricultural purposes. The total sum expended by the Highland and Agricultural Society in such Grants shall not exceed the sum of £210 in any one year.

2. The portion of the Grant to any one Association or Society shall not exceed the sum of £15 in any one year.

3. The Grant will be available only for Stallions which, for the year to which the Grant applies, are Registered in the Register of Certified Draught Stallions published by the Board of Agriculture. (For information regarding the Registration of Stallions, apply to the Secretary of the Board of Agriculture, 4 Whitehall Place, London, S.W.)

4. The Grant will continue for three years provided the Association receiving the Grant shall hire a Registered Stallion in the two intermediate years.

5. In the event of a Horse not being engaged in any one year while the provisions of the Grant are in force, the Grant made by the Highland and Agricultural Society will cease.

6. RULES 2 (Committee and Convener), 10 (Reports), 11 (Time of Payment), 12 (Renewal of Grant), and 13 (Disposal of Applications) applicable to Section 1, shall be applicable to this Section.

DISTRICTS.

Final Year.

1. DUMBARTONSHIRE HORSE-BREEDING SOCIETY.—*Convener*, Alexander Y. Allan, Aitkenbar Farm, Dumbarton; *Secretary*, William Davie, 253 Main Street, Alexandria. Granted 1912.
2. KINROSS-SHIRE HORSE-BREEDING SOCIETY.—*Convener*, William C. Hunter, W.S., of Longair, Glenfarg; *Secretary*, John A. Hepburn, M.R.C.V.S., Ardmohr, Milnathort. Granted 1912.
3. LOWER WARD OF RENFREWSHIRE STALLION SOCIETY.—*Convener*, John Telfer, Branchal, Bridge of Weir; *Secretary*, A. Douglas Murray, 2 Church Place, Greenock. Granted 1912. (£15 not paid in 1912—Stallion not registered.)

4. AIRD AND STRATHGLASS AGRICULTURAL ASSOCIATION.—*Convener*, R. A. Smith, Wester Lovat, Beaully; *Secretary*, James Ingram, Parish Council Office, Beaully. Granted 1912. (£15 not paid in 1912—Stallion not registered.)

2nd Year.

5. CROMAR AND UPPER DEESIDE STALLION SOCIETY.—*Convener*, James Henry, Kinaldie, Dinnet; *Secretary*, William Anderson, Hopewell, Tarland. Granted 1914.
6. CUMBERNAULD, KILSYTH, AND KIRKINTILLOCH CLYDESDALE HORSE SOCIETY.—*Convener*, Alexander Whitelaw, Gartshore, Kirkintilloch; *Secretary*, Alexander Park, 175 Hope Street, Glasgow. Granted 1914.
7. UPPER NITHSDALE HORSE SOCIETY.—*Convener*, Charles W. Ralston, Dabton, Thornhill; *Secretary*, D. Paterson, Solicitor, Thornhill. Granted 1914.
8. SCONE, STRATHORD, AND MURTHLY PREMIUM HORSE SOCIETY.—*Convener*, John Chalmers, Westwood, Stanley; *Secretary*, James Stewart, Friarton, Perth. Granted 1914.

1st Year.

9. EAST MAINLAND CO-OPERATIVE HORSE-BREEDING SOCIETY.—*Convener*, John Clouston, Graemeshall, Holm, Orkney; *Secretary*, Andrew Skea, Aikerskaill, Deerness, Orkney. Granted 1916.
10. INVERNESS DISTRICT HORSE-BREEDING SOCIETY.—*Convener*, Hugh M'Kintosh, Rosevalley, Croy; *Secretary*, William R. Ross, Milton of Culloden, Inverness. Granted 1916.
11. KINTYRE HORSE-BREEDING SOCIETY.—*Convener*, John Gemmell, Campbeltown; *Secretary*, Hugh Baird, Ugadale Estate Office, Campbeltown. Granted 1916.

Intermediate Year—Grant in Abeyance.

12. DEESIDE STOCK IMPROVEMENT SOCIETY.—*Convener*, Sir Thomas Burnett of Leys, Bart., Crathes Castle; *Secretary*, John Cooper, Ley, Banchory. Granted 1913.
13. EAST OF FIFE ENTIRE HORSE SOCIETY.—*Convener*, John Rodger, Balgone, St Andrews; *Secretary*, Alexander Brown, Pitcorrhie Mains, Kilconquhar. Granted 1913. (£15 not paid in 1913—Stallion not registered.)
14. GIGHA HORSE-BREEDING SOCIETY.—*Convener*, W. J. Yorke Scarlett of Gigha, Argyllshire; *Secretary*, W. W. Philip, Estates Office, Gigha. Granted 1915.
15. CARSE AND DUNDEE DISTRICT STALLION SOCIETY.—*Convener*, J. W. Colville, Leoch, Auchterhouse; *Secretary*, William L. Thoms, Benzie, Invergowrie. Granted 1915.
16. BUCHLYVIE AND VALE OF MENTEITH HORSE-BREEDING SOCIETY.—*Convener and Secretary*, John Drysdale, 5 St Andrew Square, Edinburgh. Granted 1915.

In 1915.

Nos. 1, 2, 3, and 4 are in competition for the final year.

Nos. 5, 6, 7, and 8 are in competition for the second year.

Nos. 9, 10, and 11 are in competition for the first year.

Nos. 12, 13, 14, 15, and 16 are in abeyance, and compete for local premiums. (See Rule 4.)

SPECIAL GRANTS.

ANNUAL.

- £40 to the Highland Home Industries Association.—*Secretary*, Miss Jessie D. C. Ross, Riverfield, Inverness. Granted 1895. (Did not hold a competition in 1899, 1900, 1908, 1914, or 1915.)
- £20 to the Ayrshire Agricultural Association, to be competed for at the Dairy Produce Show at Kilmarnock.—*Convener*, James Middleton, Estate Office, Braehead, Kilmarnock; *Secretary*, John Howie, 58 Alloway Street, Ayr. Granted 1872. (No competition 1914 and 1915.)
- The British Dairymaids' Association.—*Convener*, Mrs J. H. R. Turnbull, 7 W. Maitland Street, Edinburgh; *Secretary*, Miss A. H. Smith, 12 Grassmarket, Edinburgh. 1 Minor Gold Medal and 1 Medium Silver Medal for Champion Butter-making Competitions. Granted 1908. (In abeyance 1914 and 1915—no competition.)

IN ALTERNATE YEARS.

- £5 to Shetland Agricultural Society.—*Convener*, J. M. Goudie, Lerwick; *Secretary*, James J. Brown, Lerwick. Granted 1893. (In abeyance—no Show in 1914 or 1915.) (Grant in 1916.)
- £3 to Unst, Shetland.—*Convener*, Alexander M. Sandison, Moundeville, Uyasound, Shetland; *Secretary*, Thomas G. Hunter, Clivocast, Uyasound, Unst. Granted 1911 for 3 alternate years. (No Show 1915.) (Grant in 1916.)
- £3 to Orkney.—*Convener*, James Johnston, Orphir House, Orphir, Orkney; *Secretary*, D. B. Peace, jun., Auctioneer, Kirkwall. Granted 1883. (No Show in 1915.) (Grant in 1916.)
- £3 to Sanday, Orkney.—*Convener*, W. Cowper Ward, Scar House, Sanday, Orkney; *Secretary*, James Irvine, Stove Farn, Sanday, Orkney. Granted 1902. (In abeyance 1915—no Show held.) (Grant in 1916.)
- £3 to North Uist Agricultural Society.—*Convener*, Dr M. T. Mackenzie, J.P., Scolpaig, North Uist; *Secretary*, H. H. Mackenzie, J.P., Balelone, Lochmaddy. Granted in 1915 for 3 alternate years. (In abeyance 1915—no Show held.) (Grant in 1916.)
- £3 to West Mainland, Orkney.—*Convener*, J. M. H. Robertson, Lyking, Sandwick, Orkney; *Secretary*, George Learmonth, Pow, Quoyloo, by Stromness, Orkney. Granted 1900. (Grant in 1916.)
- Ross-shire Crofters' Show.—*Convener*, T. W. Cuthbert, Achindunie, Alness; *Secretary*, Robert Calder, Commercial Bank House, Alness. Granted 1910 for 3 alternate years, and 2 Silver Medals in the 2 intermediate years, which may be awarded to animals of any pure breed or cross. (In abeyance 1914 and 1915—no Show held.) Medals in 1916.

GRANT IN ABEYANCE.

- £3 to East Mainland, Orkney.—*Convener*, John Clouston, Graemeshall, Holm, by Kirkwall; *Secretary*, Alexander Calder, Seabay, Tankerness. Granted 1898.
- £3 to Rousay, Orkney.—*Convener*, John Logie, Trumland, Rousay, Orkney; *Secretary*, John Harrold, Springfield, Rousay. Granted 1903. (No Show 1915.)
- £3 to South Ronaldshay and Burray, Orkney.—*Convener*, Archibald Allan, St Margaret's Hope, Orkney; *Secretary*, George Esson, St Margaret's Hope, Orkney. Granted 1904. (No Show 1915.)

MEDALS IN AID OF PREMIUMS GIVEN BY LOCAL SOCIETIES.

The Society, being anxious to co-operate with local Associations, will give a limited number of Silver Medals annually to Societies, not on the list of Cattle, Horse, or Sheep Premiums, in addition to the Money Premiums awarded in the Districts, for—

1. Best Bull, Cow, or Heifer of any pure breed included in Section 1.
2. Best Stallion, or Mare of any pure breed included in Section 1.
3. Best Tup, or Pen of Ewes of any pure breed included in Section 1.
4. Best Boar, Sow, or Breeding-Pig of any pure breed.
5. Best Pens of Poultry.
6. Best Sample of any variety of Wool.
7. Best Sample of any variety of Seeds.
8. Best managed Farm.
9. Best managed Green Crop.
10. Best managed Hay Crop.
11. Best managed Dairy.
12. Best Sweet-Milk Cheese.
13. Best Cured Butter.
14. Best Fresh Butter.
15. Best collection of Roots.
16. Best kept Fences.
17. Male Farm Servant who has been longest in the same service, and who has proved himself most efficient in his duties, and to have invariably treated the animals under his charge with kindness.
18. Female Servant in charge of Dairy and Poultry who has been longest in the same service, and who has proved herself most efficient in her duties, and to have invariably treated the animals under her charge with kindness.
19. Best Sheep-Shearer.
20. Most expert Hedge-Cutter.
21. Most expert Labourer at Draining.
22. Best Maker of Oat-Cakes.

It is left to the local Society to choose out of the foregoing list the classes for which the Medals are to be competed.

The Medals are granted for two years, and lapse if not awarded in those years.

No Society shall receive more than two Medals in any year.

Aberdeenshire.

1. **MARNOCH AND CORNHILL AGRICULTURAL SOCIETY.**—*Convener*, James Andrew, Kinnairdy Castle, Bridge of Marnoch; *Secretary*, David Findlay, Bank Agent, Aberchirder. 2 Medals. 1914. (In abeyance 1914 and 1915—no Show held.)
2. **NEW DEER AGRICULTURAL SOCIETY.**—*Convener*, David M. Godsman, Mains of Fedderate, Maud; *Secretary*, P. Crichton, New Deer. 2 Medals. 1914. (In abeyance 1914—no Show held.)
3. **VALE OF ALFORD AGRICULTURAL ASSOCIATION.**—*Convener*, William A. Mitchell, Auchnagathle, Whitehouse, Aberdeen; *Secretary*, W. Alexander Ronald, East Cividley, Keig, Whitehouse. 2 Medals. 1915. (In abeyance 1915—no Show held.)

Argyllshire.

4. MULL AND MORVERN AGRICULTURAL SOCIETY.—*Convener*, J. H. Munro Mackenzie of Calgary, Mull; *Secretary*, Alexander J. Fraser, Clydesdale Bank, Tobermory. 2 Medals. 1913. (In abeyance 1914 and 1915—no Show held.)

Ayrshire.

5. CRAIGIE FARMERS' SOCIETY.—*Convener*, James Kilpatrick, Craigie Mains, Kilmarnock; *Secretary*, W. A. Rawson, Craigie, Kilmarnock. 2 Medals. 1915.
6. BEITH FARMERS' SOCIETY.—*Convener*, David Kerr, Marshalland, Beith; *Secretary*, Matthew Gilmour, Clydesdale Bank, Beith. 2 Medals. 1916.

Banffshire.

7. NORTHERN SEEDS AND ROOTS ASSOCIATION.—*Convener*, George Smith, Ordens, Boyndie, Banff; *Secretary*, James Young, 28 Seafield Street, Portsoy. 2 Medals. 1914. (In abeyance 1915—no Show held.)
8. ABERDOUR AND NORTH-EAST AGRICULTURAL SOCIETY.—*Convener*, Alexander Beddie, Bridgend, Fraserburgh; *Secretary*, Robert Pittendrigh, jun., Newseat, Fraserburgh. 2 Medals. 1915. (In abeyance 1915—no Show held.)

Caithness.

9. CAITHNESS AGRICULTURAL SOCIETY.—*Convener*, D. P. Henderson of Stemster, Halkirk; *Secretary*, George Harrold, Accountant, Wick. 2 Medals. 1914. (In abeyance 1915—no Show held.)

Dumfriesshire.

10. SANQUHAR FARMERS' SOCIETY.—*Convener*, James Moffat, Gateside, Sanquhar; *Secretary*, W. M. Henderson, Solicitor, Sanquhar. 2 Medals. 1914. (In abeyance 1914 and 1915—no Show held.)

Fifeshire.

11. FIFE AGRICULTURAL SOCIETY.—*Convener*, David Ferrie, Parbroath, Cupar; *Secretary*, F. W. Christie, Eden View, Cupar-Fife. 2 Medals. 1914. (In abeyance 1915—no Show held.)

Lanarkshire.

12. SHOTTS CALDERWATER FARMERS' SOCIETY.—*Convener*, John Weir, Shottsburn, Holytown; *Secretary*, Alexander Waddell, 49 Wesleyan Street, Glasgow. 2 Medals. 1916.

Orkney.

13. SHAPANSEY AGRICULTURAL ASSOCIATION.—*Convener*, James Johnston of Coubister, Orphir House, Orphir, Orkney; *Secretary*, William Robertson, Elwickbank, Shapansey, Orkney. 2 Medals. 1915. (In abeyance 1915—no Show held.)

Perthshire.

14. MOULIN AGRICULTURAL ASSOCIATION.—*Convener and Secretary*, Robert M'Gillewie, Dunkeld. 2 Medals. 1913. (In abeyance 1914 and 1915—no Show held.)
15. DUNBLANE AGRICULTURAL SOCIETY.—*Convener*, A. H. Anderson, J.P., Kippendavie Estate Office, The Firs, Dunblane; *Secretary*, John Stewart, Solicitor, Dunblane. 2 Medals. 1916.

Stirlingshire.

16. DENNY AND DUNIPACE AGRICULTURAL ASSOCIATION.—*Convener*, William Chapman, Bank of Scotland, Denny; *Secretary*, Alexander Henry, Solicitor, 30 Glasgow Road, Denny. 2 Medals. 1915.

Applications from other Districts must be lodged with the Secretary of the Society by 1st November next.

RULES OF COMPETITION.

1. All Competitions must be at the instance of a local Society.
2. The classes for which Medals are granted must be in accordance with the list at page 53. The Committee shall select the classes, and specify them in the Report.
3. A Committee of Management shall be appointed, and the Convener of the Committee must be a Member of the Highland and Agricultural Society.
4. The Money Premiums given in the District must be not less than £2 for each Medal claimed.
5. The Medal for Sheep-Shearing shall always accompany the highest Money Premium.
6. There must not be fewer than three competitors in all the classes.
7. Regarding Reports, despatch of Medals, and application for renewal of Grant, Rules 10 and 11, Section I., will apply.
8. When a grant of Medals has expired, the District cannot apply again for Medals for two years.

PLOUGHING COMPETITIONS.

The Minor Silver Medal will be given to the winner of the first Premium at Ploughing Competitions, provided a Report in the following terms on the official form is made to the Secretary, within one month of the Competition, by a Member of the Society. Forms of Report to be had on application.

FORM OF REPORT.

I, _____ of _____, Member of the Highland and Agricultural Society, hereby certify that I attended the Ploughing Match of the _____ Association at _____ in the county of _____ on the _____ when _____ ploughs competed; _____ of land were assigned to each, and _____ hours were allowed for the execution of the work. The sum of £ _____ was awarded in the following proportions, viz. :—

[Here enumerate the names and designations of successful Competitors.]

RULES OF COMPETITION.

1. All Matches must be at the instance of a local Society or Ploughing Association, and no Match at the instance of an individual, or confined to the tenants of one estate, will be recognised.

2. The title of such Society or Association, together with the name and address of its Secretary, must be registered with the Secretary of the Highland and Agricultural Society, 3 George IV. Bridge, Edinburgh.

3. Not more than one Match in the same season can take place within the bounds of the same Society or Association.

4. All reports must be lodged within one month of the date of the Match, and certified by a Member of the Highland and Agricultural Society who was present at it.

5. A Member can only report one Match; and a Ploughman cannot carry more than three Medals in the same season.

6. To warrant the grant of the Medal there must have been twelve ploughs in Competition, and not less than Three Pounds awarded in Prizes by the local Society. The Medal to be given to the winner of the first prize.

7. The Local Committee or Society may, if they desire, arrange to let each ploughman have one person to guide the horses for the first two and the last two furrows, but in no case shall ploughmen receive any other assistance, and their work must not be set up nor touched by others. Attention should be given to the firmness and sufficiency of the work below more than to its neatness above the surface.

8. The Local Committee is required to fix the time to be allowed for ploughing the portion of land, and they are recommended that the time be at the rate of not more than ten hours per imperial acre on light land, and fourteen hours on heavy or stony land.

LONG SERVICE CERTIFICATES AND MEDALS.

Certificates and Medals for long service are awarded by the Society to farm servants, male or female, having an approved service of not less than thirty years—(a) with one employer on the same or different holdings; (b) on the same holding with different employers. These Certificates and Medals will be issued as applications are received.

Forms to be obtained from the Secretary.

CLASS III.

COTTAGES AND GARDENS.

The following Premiums are offered for Competition in the Parishes after mentioned.

The Premiums are granted for two years.

PREMIUMS FOR BEST KEPT COTTAGES AND GARDENS.

1. Best kept Cottage	.	.	.	.	.	£1	0	0
Second best	.	.	.	.	.	0	10	0
2. Best kept Cottage Garden	.	.	.	.	.	1	0	0
Second best	.	.	.	.	.	0	10	0

RULES OF COMPETITION.

1. Competitions may take place in the different parishes for Cottages and Gardens, or for either separately.

2. The occupiers of Lodges at Gentlemen's Approach Gates and Gardeners' Houses are excluded, as well as others whom the Committee consider, from their position, not to be entitled to compete. The inspection must be completed by the 1st of October. In making the inspection, the Conveners may take the assistance of any competent judges.

3. It is left to the Committee of the District to regulate the maximum annual rent of the Cottages, which may, with the garden, be from £5 to £7.

4. To warrant the award of full Premiums, there must not be fewer than three competitors in each class. If there are less than three competitors in each class, only half Premium will be awarded.

5. A person who has gained the highest Premium cannot compete again.

6. If the Cottage is occupied by the proprietor, the roof must be in good repair; if the roof is thatch, it must be in good repair, though in the occupation of a tenant. The interior and external conveniences must be clean and orderly; the windows must be free of broken glass, clean, and affording the means of ventilation. Dunghills, and all other nuisances, must be removed from the front and gables. In awarding the Cottage Premiums, preference will be given to Competitors who, in addition to the above requisites, have displayed the greatest taste in ornamenting the exterior of their houses, and the ground in front and at the gables.

7. In estimating the claims for the Garden Premiums, the judges should have in view—the sufficiency and neatness of the fences and walks; the cleanness of the ground; the quality and choice of the crops; and the general productiveness of the garden.

8. Reports, stating the number of Competitors, the names of successful parties, and the nature of the exertions which have been made by them, must be lodged with the Secretary of the Highland and Agricultural Society *on or before the 1st November next*.

9. When a grant of Money has expired, the District cannot apply again for aid for four years.

Parishes desirous of these Premiums must lodge applications with the Secretary *on or before the 1st November next*.

(No Money Grants offered in 1916.)

MEDALS FOR COTTAGES AND GARDENS, OR GARDEN PRODUCE, POULTRY, AND BEE-KEEPING.

1. The Society will give annually one or two Minor Silver Medals to a limited number of local Associations or individuals, who establish Competitions and Premiums for Cottages, Gardens, Garden Produce, or Bee-Keeping. The Medals will be granted for two years.

2. The Medals may be offered in any two of the following sections, *but under no circumstances will the two Medals be given in one of the sections:—*

(1) Best kept Cottage or best kept Cottage and Garden. (One Medal only.)

(2) Best kept Garden. (One Medal only.)

(3) Best Collection of Garden Produce—Flowers excluded. (One Medal only.)

(4) Best Pen of Poultry.

(5) Honey. (One Medal only.)

3. The annual value of each Cottage, with the ground occupied in the parish by a Competitor, must not exceed £15. The occupiers of Lodges at Gentlemen's Approach Gates, and Gardeners in the employment of others, are not entitled to compete.

4. If Competition takes place for Garden Produce, such produce must be *bona fide* grown in the Exhibitor's Garden. He will not be allowed to make up a collection from any other Garden. The produce must consist of Vegetables, or Vegetables and Fruit (not Fruit alone). Flowers are excluded.

5. The Honey must be the produce of the Exhibitor's own Hives.

6. To warrant the award of a Medal, there must not be fewer than three Competitors.

7. Blank forms for Reports of Competitions will be furnished to the Secretaries of the different Districts. These must, in all details, be completed and lodged with the Secretary of the Highland and Agricultural Society as soon as possible after the Show, and in no case later than *1st November*, for the approval of the Directors, against whose decisions there shall be no appeal.

8. When a grant of Medals has expired, the District cannot apply again for aid for two years, and if no competition takes place in a District for two years the grant expires.

9. Applications for these Medals must be made *before 1st November next*.

Aberdeenshire.

1. CRUDEN HORTICULTURAL SOCIETY.—*Convener*, Robert Brand, Ardifferry, Hatton, R.S.O., Aberdeen; *Secretary*, John Robb, Hatton, R.S.O., Aberdeen. 2 Medals. 1913. (In abeyance 1914 and 1915—no Show held.)
2. KINELLAR HORTICULTURAL AND POULTRY SHOW.—*Convener*, W. S. Cantlay, Glasgoego Cottage, Kinellar; *Secretary*, Neil Smith, Kinellar. 2 Medals. 1914. (In abeyance 1915—no Show held.)

Fifeshire.

3. NEWBURGH GARDENING SOCIETY.—*Convener*, Andrew Kay, Hillside Cottage, Newburgh; *Secretary*, David M. Adamson, High Street, Newburgh. 2 Medals. 1916.

Perthshire.

4. BRACO HORTICULTURAL SOCIETY.—*Convener*, John W. Stirling, J.P., Braco; *Secretary*, William M'Ildowie, Crofthead, Braco. 2 Medals. 1915. (In abeyance 1915—no Show held.)

Renfrewshire.

5. INVERKIP, WEMYSS BAY, AND SKELMORLIE HORTICULTURAL SOCIETY.—*Convener and Secretary*, Robert H. Hamilton, Clydesdale Bank, Skelmorlie. 2 Medals. 1914. (In abeyance 1915—no Show held.)
6. "SIR JOHN STIRLING MAXWELL" GARDENS HORTICULTURAL SOCIETY.—*Convener*, J. Campbell Murray, Hagg's Castle, Pollok-shields; *Secretary*, John R. Bain, 7 Holmhead Crescent, Cathcart. 2 Medals. 1916.

HOEING COMPETITIONS.

Tyrie and North-East Ploughing and Hoeing Society.—*Convener*, John Bell, Tyrie Mains, Fraserburgh; *Secretary*, Robert Pittendrigh, jun., Newseat, Fraserburgh. Silver Medal for Hoeing Competition. (Granted 1915.) (No Competition 1915.)

Central Aberdeen Hoeing Society.—*Convener*, James Durno, Rothiebrigsbane, Fyvie; *Secretary*, William Watt, Sunnyside, Wartle. Silver Medal for Hoeing Competition. (Granted 1914.)

Cromar Hoeing Association.—*Convener*, William Reid, Craskings, Tarland; *Secretary*, James M'Connach, Gordons Cottage, Tarland. (Granted 1916.)

EDINBURGH SHOW, 1916

The following Resolution was adopted by the Board (1st December 1915): "That in the present circumstances no steps should be taken by the Directors towards holding a Show next year."

MEMBERS ADMITTED SINCE THE LIST WAS PUBLISHED IN 1915.

ARRANGED ACCORDING TO SHOW DIVISIONS.

67 ELECTED 2ND JUNE 1915.
2 FREE LIFE MEMBERS.
9 ELECTED 12TH JANUARY 1916.

78

1.—GLASGOW DIVISION.

ARGYLL.

Admitted

1915 ARGYLL, The Duke of, Inveraray Castle,
Inveraray
1915 Slocock, Frederick E., Achanelid, Glen-
daruel

AYR.

1915 Aird, D. J. C., 28 Witch Road, Kilmar-
nock
1915 Scott, William, Dalfram, Muirkirk

LANARK.

1915 Fenton, J. H., Bonclair, Lanark
1915 Fleming, James, Hawkwood, Strathaven
1915 Kirkhope, William G., 16 North Gardner
Street, Partickhill, Glasgow
1915 M'Lachlan, Duncan, 96 Queensborough
Gardens, Hyndland, Glasgow
1915 Neilson, George, Skeoch Farm, East
Kilbride
1915 Stuart, Alexander, Estates Office, Cart-
land, Lanark

2.—PERTH DIVISION.

FIFE.

1916 Berwick, Andrew, jun., Hayston,
Leuchars

FORFAR (WEST).

1915 Carlyle, John A. (Edinburgh and East
of Scotland College of Agriculture),
2 Addison Road, Arbroath
1916 Drysdale, B. Douglas, Haughs of
Cossans, Forfar

PERTH.

1915 Brown, Peter, Manager, Wester Cluny,
Pitlochry

3.—STIRLING DIVISION.

PERTH.

1915 Comrie, Peter, Drummie Farm, Orleff
1916 Fairweather, Robert, Factor, Blair
Drummond
1915 Lithgow, John, The Knowe, Dunblane

STIRLING.

1915 Aitkenhead, David M., Roughlands,
Carron
1915 Forbes, Charles William, J.P., D.L., of
Callendar, Callendar House, Falkirk
1915 Kerr, William, Bandedeath, Stirling
1915 King, James, Old Keir, Bridge of Allan
1915 Laing, William, Cowiehall, Bannockburn
1915 Logan, John, Powis Mains, Stirling
1915 Oswald, John, Northfield, Denny

4.—EDINBURGH DIVISION.**EDINBURGH.**

- | | |
|---|--|
| <p>1915 Callander, A. D. (Board of Agriculture for Scotland), 29 St Andrew Square</p> <p>1916 Christie, Henry Randolph, Felton Mains, Carnamah, Perth, Western Australia (85 Mayfield Gardens, Edinburgh)</p> <p>1915 Currie, Hugh K., City Farm, West Calder</p> <p>1915 Davidson, James D., 3 Oxford Street</p> <p>1915 Dun, George P., Gilston, Heriot</p> <p>1916 Fairley, James, 83-91 Leith Street, Edinburgh</p> <p>1915 Francis, P. A. (Board of Agriculture for Scotland), 29 St Andrew Square</p> <p>1915 Graham, Robert, Crosshouse, Milton Bridge</p> <p>1915 Hamilton, John, Greenlaw Mains, Glen-corse</p> <p>1915 Hogg, W. H. (Board of Agriculture for Scotland), 29 St Andrew Square</p> <p>1915 Macdonald, D., Harlaw, Balerno</p> <p>1915 Macpherson, Donald (Edinburgh and East of Scotland College of Agriculture), 13 George Square</p> <p>1916 M'William, W. N., Board of Agriculture for Scotland, 29 St Andrew Square</p> <p>1915 Main, Alexander (Board of Agriculture for Scotland), 29 St Andrew Square</p> <p>1915 Morrison, Mark C., Wester Dalmeny, Dalmeny</p> <p>1915 Munro, John (Thomas Munro & Son), 21 Grassmarket</p> | <p>1915 Ramsay, J. M. (Board of Agriculture for Scotland), 29 St Andrew Square</p> <p>1915 Rankin, James, West Mains, West Mains Road, Edinburgh</p> <p>1915 Ritchie, John F., Castle Law, Milton Bridge</p> <p>1915 Scott, J. D. (Board of Agriculture for Scotland), 29 St Andrew Square</p> <p>1915 Smith, William, Milton Bank, Milton Bridge</p> <p>1916 Stewart, James Cumming, 18 South St Andrew Street, Edinburgh</p> <p>1915 Stewart, John, Nottlingflat, Heriot</p> <p>1915 Thomson, F. A. (Board of Agriculture for Scotland), 29 St Andrew Square</p> <p>1915 Usmar, F. W., 4 Elm Place, Leith</p> <p>1915 Weatherill, Charles (Board of Agriculture for Scotland), 29 St Andrew Square</p> |
|---|--|

EAST LoTHIAN.

- 1915 Russell, Peter, West Windygoul, Tranent

WEST LoTHIAN.

- 1915 Gordon, David R., Merchant, Bathgate
- 1915 Sayers, J., jun., Home Farm, Blackridge, West Lothian
- 1915 Young, James W., Kinnell Estate Office, Boness

5.—ABERDEEN DIVISION.**ABERDEEN.**

- 1915 Ingram, Alexander C., Bridgend, Auchterless
- 1915 Leslie, Peter, M.A., B.Sc., Lecturer on Forestry, Marischal College, Aberdeen
- 1916 Mackie, Maitland, North Ythsie, Tarves
- 1916 Ogston, James, Bridgend, Port Erroll

KINCARDINE.

- 1915 Cargill, Charles, Pitarrow Mains, Laurencekirk
- 1915 Mackay, John, Thornyhill, Fettercairn
- 1915 Walker, George, Redmoos, Nigg, Kincardineshire
- 1915 Watson, John, Whins and Sauchieburn, Luthermuir, Laurencekirk

6.—DUMFRIES DIVISION.**DUMFRIES.**

- 1915 Henderson, John, Annandale Estates Office, Moffat

KIRKCUDBRIGHT.

- 1915 Gardener, John, Upper Rusko, Gatehouse

WIGTOWN.

- 1915 McNeill, William L., of Sheenanton, Kirkcowan

7.—INVERNESS DIVISION.**ELGIN.**

- 1915 Watson, Harry, Darnaway, Forbes—*Free Life Member*

ROSS AND CROMARTY.

- 1915 Peterkin, George, Teawig, Munloch

8.—BORDER DIVISION.

BERWICK.

1915 Calder, Alexander M., Lintlaw, Chirnside

PEEBLES.

1915 Simpson, Henry D., Ladyurd, Dolphinton

ROXBURGH.

1915 Carruth, Allan (Edinburgh and East of Scotland College of Agriculture), Forresterfield, Kelso

1915 Dalgleish, William, Oakbank, Hawick
1915 Elliot, Thomas R., Attonburn, Kelso

SELKIRK.

1915 Dun, John (of John Dun & Co., Merchants), Galashiels
1915 Stewart, Robert, Lewinshope, Selkirk

ENGLAND.

1915 Bird, G. Bonham, Colyford, Devonshire

1915 Gunther, Charles E., Tongswood, Hawkhurst, Kent

1916 Hewett, A. W., Manager (Imperial Live Stock Insurance Co., Ltd.), 17 Pall Mall East, London, S.W.

1915 Mackay, James W., Jervaulx Abbey, Middleham, Yorks.—*Free Life Member*

FREE LIFE MEMBERS.

Winners of First-Class Certificates in Forestry.

1915 Mackay, James W., Jervaulx Abbey, Middleham, Yorks.

1915 Watson, Harry, Darnaway, Forres

Highland and Agricultural Society of Scotland

I N D E X

TO

THE FIFTH SERIES

OF

THE SOCIETY'S TRANSACTIONS

(VOLUMES XXII. TO XXVIII, INCLUSIVE)

FROM 1910 TO 1916

IN TWO PARTS

I. INDEX OF AUTHORS' NAMES

II. INDEX OF SUBJECTS AND PLACES

EDINBURGH:

WILLIAM BLACKWOOD & SONS, 45 GEORGE STREET
AND 37 PATERNOSTER ROW, LONDON

1916

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